TITLES UNDER EXEMPLAR INSTRUCTIONAL MATERIAL

Basic Skills in Carpentry (Class VI)
Creative Printing (Class VII/VIII)
Leather Work (Class VI/VII/VIII)
Electricity at Work (Classes VI—VIII)
Sheet Metal Work (Class VII/VIII)
Milk Production and Handling (Classes IX—X)
Milk and Milk Products (Classes IX—X)
Woodcraft (Class IX)
General Horticulture (Classes IX—X)
Scooter and Motorcycle
  (Repair and Maintenance) (Classes IX—X)
Meals for the Family—Volume I (Class IX)
Care of the Household (Classes IX—X)
Introduction to House-wiring (Classes IX—X)
Plant Protection (Classes IX—X)
Repair and Maintenance of Household
  Electrical Appliances (Classes IX—X)
Electronics Technology (Classes IX—X)
Photography (Class IX)
Basic Office Practice (Classes IX—X)
Basic Book-Keeping (Classes IX—X)
Introduction to Plumbing (Classes IX—X)

Exemplar Instructional Material
for
Pre-Vocational Course under
Work Experience

INTRODUCTION TO HOUSE-WIRING

Instructional-cum-Practical Manual
for Classes IX and X

SACHCHIDANANDA RAY
Project Coordinator

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

August 1987
Sravana 1909

P.D. 10T-DPG

©*National Council of Educational Research and Training, 1987*

ALL RIGHTS RESERVED

☐ No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.

☐ This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold, hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.

☐ The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

Publication Team

Prabhakar Dwivedi	Chief Editor	C.N. Rao	Chief Production Officer
D.P. Gupta	Editor	D. Sai Prasad	Production Officer
Benoy Banerjee	Assistant Editor	C.P. Tandan	Art Officer
		Rati Ram	Production Assistant

Cover Design: LEENA CHACHAD

Rs. 10.65

Published at the Publication Department by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110016 and printed at Raj Bandhu Industrial, Co., C-61, Mayapuri, Phase II, New Delhi 110064

Foreword

The National Council of Educational Research and Training NCERT developed its new framework document for the Ten-Year School, titled "National Curriculum for Primary and Secondary Education—a Framework". This document is a forerunner of the new National Policy on Education (NPE) 1986, which incorporates the basic philosophy of the national curriculum into the policy framework. Both the Framework and the Policy were developed after a great deal of national debate and deliberations through national and regional seminars and a variety of other modes of interaction and exchange of ideas. These two historic documents hold the promise of revolutionizing the content and process of school education throughout the country. The Programme of Action document, which provides an elaboration of NPE 1986, has recommended the development of curricular guidelines and exemplar curricular and instructional materials. In order to provide details in respect of various ideas in the two documents it was felt necessary to develop detailed curricular guidelines, exemplar curricular frames and instructional materials in various areas.

The Policy envisages integration of productive work with education and states that "Work Experience, viewed as purposive and meaningful manual work, organised as an integral part of the learning process and resulting in either goods or services useful to the community, is considered an essential component at all stages of education, to be provided through well-structured and graded programmes. It would comprise activities in accord with the interests, abilities and needs of students, the level of skills and knowledge to be upgraded with the stages of education. This experience would be helpful on their entry into the workforce. Pre-vocational programmes provided at the lower secondary stage will also facilitate the choice of the vocational courses at the higher secondary stage."

In pursuance of this Policy and the Programme of Action and to maintain continuity with the curricular guidelines and the syllabi developed by the NCERT, a set of exemplar instructional materials has been developed for use in schools. The present title, "Introduction to House-wiring" is a part of this series. It has been developed by the Department of Vocationalization of Education by involving experts in the subject area, teachers and curriculum experts. I am grateful to all those who have contributed to this work both within and outside the Council.

I hope the students and the teachers using this material will find it useful in performing the desired work experience activities. Further, in view of the fact that it is one in the series of exemplar instructional materials, it is also hoped that those concerned with the development of a variety of instructional materials will find it of great help in developing similar materials to suit the needs of students in widely varying situations in the country.

P.L. MALHOTRA
Director
National Council of
Educational Research and Training

New Delhi
January 1987

Preface

The NCERT document, "National Curriculum for Primary and Secondary Education—a Framework" and the National Policy on Education 1986 have accepted the concept of Work Experience to be included as an integral component of education at all stages of education, particularly the school stage. In pursuance of the conceptual framework presented in these documents the Department of Vocationalization of Education has developed guidelines for curriculum development and implementation and a set of exemplar pre-vocational courses under Work Experience. The guidelines cover all stages of school education while exemplar courses have been developed only for the upper primary and secondary stages of education. The two documents, though intelligible independently of each other, constitute two sister volumes dealing with the same subject.

The Department has gone further to develop a set of twenty exemplar instructional materials in the first instance which cover major areas of Work Experience in school education. The present title was developed in a workshop held at the NCERT, New Delhi, from 8 to 12 September 1986 in which several subject experts, teachers and curriculum specialists participated. The manuscript was further refined by Shri S. Ray, the Project Coordinator concerned with this title, and brought in the final form for publication. Kumari Ritu Verma was overall coordinator for the workshops in which the materials were developed and was helpful in keeping track of the work during the course of their publication. I wish to place on record my grateful appreciation for the work done by all concerned in respect of this publication.

It is expected that students and teachers as well as curriculum developers who use this publication would find it useful. The Department will be happy to receive their comments for further improvement of the material.

ARUN K. MISHRA
Professor and Head
Department of Vocationalization of Education

Acknowledgements

Exemplar instructional material on "Introduction to House-wiring" as a pre-vocational course under Work Experience for Classes IX and X was developed in a workshop conducted by the NCERT at New Delhi from 8 to 12 September 1986. The following experts participated in the workshop:

1. Shri Sachchidananda Ray
2. Shri P.C. Singhal
3. Shri P.N. Patil
4. Shri S.N. Rao
5. Shri P.K. Bansal
6. Shri S. Ananthamurthy

Their participation as contributors is gratefully acknowledged.

Introduction

The importance of Work Experience has been highlighted in the National Policy of Education 1986. It has emphasized that Work Experience should be in the form of well-structured graded programme comprising activities to cater to the needs of the students. The level of knowledge and skills should be upgraded with the advancement in the stages of education. Pre-vocational Courses have also been recommended to help students in entering the World of Work and to facilitate the choice of Vocational Courses at the higher secondary stages.

Electricity is extensively used in urban and rural areas and in domestic and industrial premises for the benefit of mankind. Therefore, it is necessary that every one of us become aware of the uses and application of electricity. The scope of employment in house-wiring is increasing due to massive electrification in rural areas. The students who learn house-wiring will have opportunities of wage-earning and self-employment. In view of the prospect of employment "Introduction to House-wiring" is recommended as a pre-vocational course under Work Experience for Classes IX and X.

The pre-vocational course of "Introduction to House-wiring" has been developed by the NCERT through a workshop on the above premise as it offers a work area practically in every house. Familiarization with common hand tools, electrical accessories, different types of wiring, wiring lighting and power circuits, testing of wiring circuits, earthing, etc., have been included in this pre-vocational course so as to make it relevant to the needs, interests and abilities of students.

This book contains 33 exemplar activities which can be conducted under average urban/rural school conditions provided the schools have electricty and procure the required tools, equipment and materials. Related information relevant to the activity precedes the procedural part in each activity and thus enlightens the students about the fundamentals of the activity they are going to do. Instruction for doing each activity is given step by step leading to the successful completion of the activity.

The activities illustrated in this book are self-explanatory. The students should be able to do most of the activities independently. But the teacher should provide necessary information and knowledge and demonstrate part of the activities for better learning by the students. By the end of Class X, the students should be able to carry out house-wiring under the guidance and supervision of an experienced and licensed wireman or electrician. In course of time, with adequate experience, the students will be able to work independently. This course will also prepare the students for a related vocational course at the plus two stage.

Contents

Activity 1 FAMILIARIZATION WITH GENERATION OF ELECTRICITY AND TRANSMISSION 1

Activity 2 FAMILIARIZATION WITH USES OF ELECTRICITY IN DOMESTIC AND INDUSTRIAL PREMISES 3

Activity 3 FAMILIARIZATION WITH DIFFERENT TYPES OF WIRING AND THEIR USES 5

Activity 4 FAMILIARIZATION WITH ELECTRICIANS' COMMON HAND TOOLS 9

Activity 5 FAMILIARIZATION WITH SAFETY PRECAUTIONS 12

Activity 6 ELECTRIC SHOCK AND ITS TREATMENT 14

Activity 7 FAMILIARIZATION WITH COMMON MEASURING INSTRUMENTS 19

Activity 8 FAMILIARIZATION WITH WIRES AND CABLES 23

Activity 9 FAMILIARIZATION WITH ELECTRICAL ACCESSORIES USED IN HOUSE-WIRING 26

Activity 10 USES OF SWITCHES AND FUSES AND THEIR PLACEMENT IN WIRING 29

Activity 11 SELECTION, FIXING AND WIRING A FUSE 32

Activity 12 CUTTING OF WIRES AND REMOVING INSULATION 35

Activity 13 JOINING OF WIRES FOR HOUSE-WIRING 38

Activity 14 CUTTING, JOINING AND FIXING TW BATTEN 41

Activity 15 CUTTING, JOINING AND FIXING TW CASING AND CAPPING 45

Activity 16 CUTTING, JOINING AND FIXING CONDUIT PIPE 53

Activity 17 WIRING A SINGLE LAMP AND A TWO-PIN SOCKET IN CTS/TRS 56

Activity 18 WIRING A SINGLE LAMP AND A TWO-PIN SOCKET IN CASING AND CAPPING 60

Activity 19 WIRING A SINGLE LAMP AND A TWO-PIN SOCKET IN METAL CONDUIT (SURFACE) 64

Activity 20 WIRING A SINGLE LAMP AND A TWO-PIN SOCKET IN PLASTIC CONDUIT 69

Activity 21 WIRING A SINGLE LAMP AND A TWO-PIN SOCKET IN CLEAT-WIRING 73

Activity 22 WIRING STAIRCASE LIGHT CONTROLLED BY TWO SWITCHES IN CTS/TRS 77

Activity 23 CONNECTION OF A FLUORESCENT TUBE IN AC AND DC 81

Activity 24 PREPARING A TEST LAMP 86

Activity 25 PREPARING AN EXTENSION POWER CORD WITH FUSE AND INDICATING LAMP 90

Activity 26 PREPARING A DISTRIBUTION BOARD 93

Activity 27 WIRING TWO LAMPS AND A TWO-PIN SOCKET IN CTS/TRS 95

Activity 28 WIRING THREE LAMPS AND TWO THREE-PIN SOCKETS IN CTS/TRS IN TWO CIRCUITS 98

Activity 29 TESTING OF WIRING CIRCUIT 101

Activity 30 EARTHING FOR HOUSE-WIRING 107

Activity 31 FAMILIARIZATION WITH RULES OF HOUSE-WIRING 111

Activity 32 READING LINE DRAWING OF HOUSE-WIRING 113

Activity 33 CALCULATING POWER CONSUMPTION OF HOUSE-WIRING INSTALLATION 116

ACTIVITY 1 *Time Required*: One Hour

Familiarization with Generation of Electricity and Transmission

Objectives

To familiarize the students with:

(i) Where electricity is generated.
(ii) How electricity is transmitted.
(iii) How electricity is distributed.

Related Information

The students will be told that electricity is generated in power stations and transmitted and distributed to houses and industries either through overhead lines or underground cables.

How Electricity reaches Houses, Shops and Industries

The whole electrical system is divided into four sections:

(i) Generation; (ii) Transmission; (iii) Distribution; (iv) Utilization.

Electricity is generated in power stations at 11kV (11000 volts). The major types of power stations are:

(i) Thermal Power Station (I.P. Stations, Delhi, Thermal Power Station, Badarpur)
(ii) Hydro-electric Power Station (Bhakra-Nangal)
(iii) Atomic Power Station (Tarapur, Bombay)
(iv) Diesel Power Stations (used in emergency)

Electricity is generated in these power stations *by electrical machines known as A.C. generators*, commonly known as alternators, at 11,000 volts. The alternators are driven by prime movers (steam turbines and water turbines).

Since the power stations are located at far-off distances from the actual place of use, the electricity is transmitted to the consumers by means of overhead lines, known as transmission lines at very high voltages to the receiving stations. The voltage of transmission varies—110kV, 132kV, 220kV, 400kV.

From the receiving stations the electricity is *distributed to the consumers through overhead* lines or underground cables at 3.3kV, 6.6kV or 11kV and sometimes at 33kV. The voltage is now further stepped down from 11kV to 440/230 volts (3-phase 4-wire system). The supply is now given at 230 volts to domestic consumers and at 440 volts to industries through service connections.

Note: The teacher may arrange a study visit to a nearby power station. Students should maintain a record.

ACTIVITY 2

Time Required: One Hour

Familiarization with the Uses of Electricity in Domestic and Industrial Premises

Objective

To acquaint students with the uses of electricity in houses, commercial establishments, shops and industries.

Related Information

Students will be told about the uses of electricity in houses for various purposes. They will get an overall view of the types of electrical appliances and electrical accessories used in houses. They will also know how electricity is used in the industry for lighting.

Uses of Electricity in Houses

Electricity is used in houses for the following purposes:

(i) For illuminating houses with either incandescent lamps or fluorescent tubes.
(ii) For running fans and radios.
(iii) Apart from illuminating the house which is the minimum use of electricity, the modern trend is to do almost all operations of kitchen and other miscellaneous operations with electricity. There could be a long list of electrical appliances used in the house but the most commonly used electrical applicances are:

be a long list of electrical appliances used in the house but the most commonly used electrical appliances are

immersion heater, room heater, hot plate (electrical cooking range), coffee percolator, electric kettle, geyser, room cooler, washing-machine, electric iron and mixer/grinder.

(iv) Electricity is also used in the house for call/door bell and burglar alarm.

Uses of Electricity in Industry

All industries are run with electricity. There are two types of loads in the industry: (i) power load for running electric machines and (ii) lighting load for illumination, fans, room coolers, air conditioners working at 230 volts.

Electricity comes to the house from the distribution line through a service main or service line to energy meter. Electricity is distributed in the house from the energy meter through house-wiring. There are two different main circuits: one circuit is for light, fan and 5-ampere plug and the other circuit is for electrical appliances. Then there are further sub-circuits both for lighting and power circuits (supply for light and power circuits is 230 volts). In the industry, there is three-phase four-wire supply. The lights, fans and room coolers/air conditioners are connected between each phase and the neutral wire.

ACTIVITY 3

Time Required: Two Hours

Familiarization with Different Types of Wiring and Their Uses

Objectives

(i) To familiarize students with different types of house-wiring.
(ii) To acquaint students with the uses of different types of wiring.

Related Information

Before the students do any house-wiring they should know the different types of house-wiring. They should know the particular type of wiring or the situation in which a particular type of wiring is used.

Types of Wiring

There are five types of wiring which are used for house-wiring and industrial wiring:

A. Cleat wiring
B. CTS or TRS wiring
C. LCC wiring
D. Casing-capping wiring
E. Conduit wiring
    (a) Surface conduit-wiring.
    (b) Concealed conduit-wiring.

Cleat Wiring

This type of wiring is used for giving temporary connection for (i) marriage functions; (ii) religious festivals; (iii) social functions; (iv) coal mines underground lighting connection; (v) any other function requiring electricity for short duration.

The cleat wiring can be used for giving

(i) Single phase connection.

(ii) 3-phase 3-wire connection.

(iii) 3-phase 4-wire connection.

The connection is taken from an overhead line and brought to the energy meter. The energy meter is fixed in a wooden box. The wooden box is fitted on a pole. Wires from the energy meter are taken to a distribution board to a suitable point inside the tent. The wires from the energy meter to the distribution board are supported by wooden cleats. For a single phase connection, there will be 3 wires, phase, neutral and earth wire. For cleat-wiring on walls, porcelain cleats are used. Cleats are made in two halves, one of which is grooved to receive the wire and the other half is put over it and tightened with a screw on to the wall. The cleats are used at intervals of 30 cms. It is the cheapest method of wiring. The system is most suitable for temporary wiring and can be installed quickly. Inspection, alteration and additions can be made easily. This type of wiring is not permitted for permanent wiring. While installing cleat wiring, the following points should be borne in mind:

(i) Fixing of cleats should not be more than 60 cms horizontally or vertically.
(ii) The wires must be stretched between the cleats so as to avoid contact with the wall.
(iii) Avoid sharp bends. Fix cleats on each side of the bends.
(iv) If the wires are to pass through the walls, pass them through a porcelain pipe or conduit pipe.
(v) Do not run the wires near water or gas pipe.
(vi) Do not use this type of wiring in damp places.
(vii) Within two metres above the floor, the wires must pass through a conduit or in casing capping.
(viii) Use PVC wire for this type of wiring.

CTS (Cab Tyre Sheath) or TRS (Tough Rubber Sheath): The TRS wire is available in two or three cores. The wire is flexible. The insulation is not affected by rough use, moisture, climate variations, acids, alkalies. It is slightly affected by insulating oils. The TRS wire is fixed on a wooden batten with the help of link clips. The distance between the clips is 30 cms. The wooden batten is fitted on the walls using wooden gutties. This type of wiring is comparatively cheap and can be easily fixed in less time. This type of wiring has common application in the houses and buildings owned by the average income group people.

LCC Wiring (Lead Covered Core): This type of wiring is similar to the TRS wiring except that the insulation is of lead instead of tough rubber sheath. This type of wiring is not normally used these days.

Casing-Capping Wiring: This type of wiring is used in residential buildings situated in damp location, the casing is a piece of wood 6 to 8 metres in length, the width varying from 38 mm (11/2'') to 102 mm (4'') and thickness varying from 16 mm (5/8'') to 32 mm (1¼''). This piece of wood has two grooves along the length on one side to carry the wire. Two or three wires of the same polarity may run in one groove. In no case should wires of opposite polarity run in one groove. The casing is covered by another wooden piece of small thickness but of the same width and length by means of screws. VIR or PVC wires are passed through the grooves in the casing.

The casing is fixed on the wall on wooden gutties supported on round porcelain cleats. The wooden gutties are fixed on the wall at distances not exceeding 90 cm (3ft) for gutties up to the size of 63.5 mm (2½'') and not exceeding 60 mm (2 ft) for sizes above 63.5 mm (2½''). The maximum length of casing capping available is 6 to 8 metres. Joints have therefore to be made. The various joints are: (i) Straight Joint, (ii) Tee Joint, (iii) Right-angled Joint, (iv) Corner Joint, and (v) Bridge Joint.

Conduit Wiring: Metallic pipes called conduits are either fixed on the wall known as surface conduit wiring or buried under paster known as concealed conduit wiring.

Surface Conduit Wiring: The conduit pipe is fixed on the walls on saddles with clamps. Saddles are fixed on the wall on wooden gutties. After fixing the conduit pipe on walls, VIR or PVC wires are drawn inside the conduit.

Concealed Conduit Wiring: For better appearance, the conduits are laid in the recess cut in the wall and then plastered. Wires are drawn inside the conduit with the help of a steel wire. Wires are rubbed with french chalk for easy pulling. Inspection bends and boxes are provided to facilitate the drawing in of the wires. This type of wiring, though expensive, is the best system which provides mechanical protection, safety against fire. This is the only type of wiring for workshops, industries and public places.

Before pulling in the wires in the conduit, burs should be removed to avoid damage of insulation. Plastic or wooden bush should be fitted at the ends of the pipes. It is essential that the conduits are properly earthed.

Comparison of Various Wiring Systems

S. No.	*Particulars*	*Cleat wiring*	*Casing capping*	*TRS*	*LCC*	*Conduit*
(i)	Life	short	long	long	long	very long
(ii)	Cost	low	medium	medium	more	high
(iii)	Mechanical Protection	no	good	good	good	very good
(iv)	Protection against fire	nil	nil	fire resistant	good	very good
(v)	Protection from dampness	no	slight	good	good	very good

Note: The teacher should show the students the various types of wiring in and around the vicinity.

ACTIVITY 4

Time Required: Two Hours

Familiarization with Electricians' Common Hand Tools

Objective

To familiarize the students with various types of tools and their uses.

Related Information

The student will be told about the various types of tools which are used by an electrician. They will know the proper use of these tools. This activity will be carried out by the teacher on the shop floor and all tools will be shown to the students.

Tools

(i) *Screw-driver:* It is a most important tool and is used quite often. Screw-drivers are available in various lengths and are used for opening and tightening a screw. Be careful that while using a screw-driver, the finger or any other part of the hand does not touch the blade of the screw-driver.

(ii) *Pliers*: There are different type of pliers used for different jobs.

(a) Side-cutting Pliers: These are used for cutting wires, for gripping operation by hand and for twisting wires. The handles of the pliers are insulated to avoid electric shock while working on live situations. This is one of the most commonly used pliers.

(b) Nose Pliers: There are long nose or short nose pliers used for forming eyes of wires for tightening the wire under a screw.

(c) Diagonal Cutting Pliers: It is difficult to cut a wire terminating into a holder, switches, etc. with a side-cutting pliers. Diagonal cutting pliers are used to cut wires under such odd circumstances.

(d) Slip Joint Pliers; It is used for conduit-wiring. It is used for making up lock nuts and bushing and holding conduits. The pliers have a slip joint and its jaws can be opened to a greater width.

(iii) *Pocket Knife, Sniper*: These are used for removing insulation of wires.

(iv) *Hammes:* There are two types of hammer: (a) Claw hammer and (b) Ball Pein hammer.

Claw hammers are used to extract or remove nails from wood. Ball Pein hammers are used for driving nails into wood. This is also used for fixing wooden gutties in the wall or making a hole in the wall.

(v) *Wooden Saw*: It is used for cutting casing capping, battens, round blocks, wooden boards, etc.

(vi) *Chisel*: It is used in casing capping and TRS wiring work. The cutting edge is of bevel shape. The cutting edge is about ½'' or 1''.

(vii) *Scratch Awl*: It is generally difficult to fix a wooden screw unless there is a small hole in the wood. The scratch awl is used for making a small hole to facilitate the easy fixing of the screw.

(viii) *Drill Machine*: There is a hand-operated drill machine and a power-operated drill machine. It is used for making holes in wooden boards to pass wire through them.

(ix) *Rawl Plug Tool*: Wooden gutties are fixed in the wall for fixing batten or casing on to the wall. Instead of wooden gutties rawl plug may be used for small work. Rawl plug consists of a tube of hared fibre with a central hole. To make a hole in the wall for fixing the rawl plug the rawl plug tool is used.

(x) *Hacksaw*: It is used in conduit-wiring to cut conduits of required size. Hacksaw frame is adjustable. The blade is usually 12'' long with 24 or 32 teeth per inch.

(xi) *Centre Punch*: When a hole is drilled in a metal, centre punch is used to make a small starting hole to give proper seat to the drill.

(xii) *Files*: We have files for wood work and for metal work. The file for metal work is used for removing burrs of the conduit pipe end when it is cut by hacksaw. Removing burrs is necessary to avoid damage to the insulation of wires.

(xiii) *Bench Vice*: The vice is fitted into bench. It is used for holding work pieces for doing some work on them.

(xiv) *Pipe Vice*: It is used for holding conduit pipe in the vice for cutting or making threads.

(xv) *Pipe Wrenches*: These are used for connecting or disconnecting conduit-pipe assembles.

(xvi) *Spanner Set and Adjustable Wrench*: These are used for screwing or unscrewing metal bolts, or sockets.

(xvii) *Blow Lamp*: It is used for soldering and cable jointing.

(xviii) *Neon Tester*: It is a pen-like instrument which is used by an electrician to ascertain the presence or absence of electricity in any wiring installation or equipment having the neutral earthed. The electrician stands on the ground and touches the top portion of the tester with a finger. The tip is touched on the wire. If there is a glow, it shows that there is electricity or the circuit is live. If there is no glow it means that there is no electricity.

Care to be taken in Handling Tools

(i) Sharp-edged tools should be used in such a way that the sharp edge moves away from the user.
(ii) Use proper tools for a job. For example, while opening a nut, do not use pliers but use adjustable wrench or for opening or tightening a screw use a screw driver and not a chisel.
(iii) Before using a hammer, ensure that the handle is properly fitted.
(iv) After using tools do not leave them on the top of the ladder.
(v) Only insulated hand tools should be used.

The teacher should show all the tools to the students and explain the care to be taken in handling them.

ACTIVITY 5

Time Required: Two Hours

Familiarization with Safety Precautions

Objectives

(i) To acquaint students with various safety rules.

(ii) To inculcate the habit of working safe in the students.

Related Information

Electricity is very useful and is used in all spheres of life. At the same time it is very dangerous if not used properly and carefully. The student will be told about the various safety rules; they will also be told how these safety rules are to be observed.

Safety Rules or Safety Precautions

(i) The golden rule is: Treat every electric wire or electric appliance as live.

(ii) Before touching any wire or any electrical equipment make sure that there is no electricity.

(iii) Test the presence of electricity with the help of a test lamp or line tester.

(iv) Ensure that all appliances and metal fittings are properly earthed.

(v) When the fuse blows off, the tendency is to replace this fuse by any wire available. This has to be avoided. Use the fuse of proper size.

(vi) Ensure that the switch is connected only in the phase wire.

(vii) Ensure that the fuse is connected in the phase wire.

(viii) Do not use wires of inferior insulation.

(ix) Use wires bearing the ISI mark.

(x) Use all electrical accessories bearing the ISI mark.

(xi) Handle an electrical job only when you have complete knowledge of the job.

(xii) Do *not be over-confident.* Over-confidence leads to accidents.

(xiii) Do not be neglectful while attending to an electrical job.

(xiv) Use proper tools with proper insulation.

(xv) Tools should not be blunt.

(xvi) One should be mentally and physically fit while attending to a job.

(xvii) Do not touch electrical appliance with wet hands. The resistance of the body decreases when it is wet.

(xviii) Do not store combustible material near the switch board.

(xix) Do not overload socket outlets.

(xx) Make proper joints.

(xxi) Tape all joints with insulation tape of good quality.

(xxii) As far as possible stand on a wooden board or a rubber mat while operating an electrical appliance.

(xxiii) While operating electrical appliances switch off the supply before touching them.

(xxiv) Do not insert wires on the plug witl plug top.

(xxv) Insert dummy plug tops on socket lets to avoid children inserting fingers.

(xxvi) Always switch off the supply befor placing a fuse or a lamp.

(xxvii) Do not disconnect plug point by ting flexible chord.

(xxviii) Locate switches outside bathroom

(xxix) Use concealed conduit wiring in rooms.

(xxx) Put a mark of permanent natu identify phase and neutral as P and N o switch board.

(xxxi) The workman should seat himsel safe position in such a way that in the eve accidents he falls away from the live wire.

The Indian Electricity Rules 1956 are lable. They deal with safety rules, shock ment, etc. Charts containing detailed instru for treating a person suffering from electric are also available.

ACTIVITY 6 *Time Required*: Two Hours

Electric Shock and Its Treatment

Objectives

(i) To enable students understand how shock is received.

(ii) To develop understanding about body resistance and other factors that influence electric shock.

(iii) To develop safety habit for preventing electric shock.

(iv) To develop skills of shock-treatment to be followed as a first aid.

Related Information

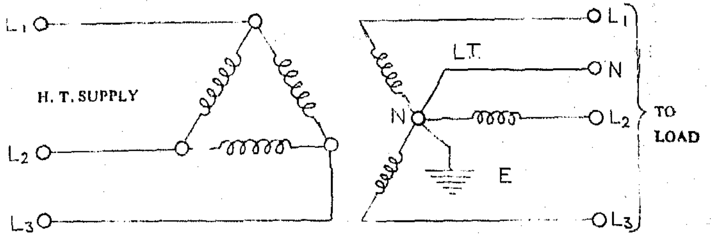

Fig. 6.1 DISTRIBUTION SYSTEM

Distribution transformers are used for supplying electric power to the consumers. The H.T. side is normally delta-connected and the L.T. side is star-connected for supplying lighting, heating and power loads. The neutral wire is earthed at the sub-station as shown in Fig. 6.1. The human body is a conductor. When the phase (live) wire touches the body current flows through the body and the muscular functions of the body are paralysed as shown in Fig. 6.2. The effect of electric shock may be death due to

(a) Fibrillation of heart i.e. damaging the heart to small pieces causing stoppage of breathing.

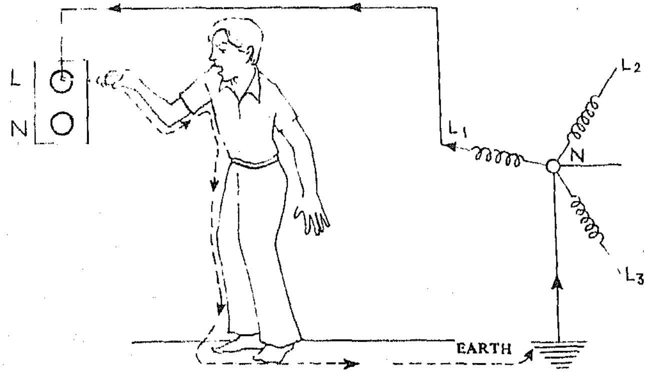

Fig. 6.2 GETTING ELECTRIC SHOCK

(b) Stopping of breathing action caused by blockage in the nervous system controlling respiration.

(c) Over-heating or burning of the body.

The fibrillation of the heart is the most serious cause of death and there is no cure, although there is possibility of rescuing a man who has suffered by the other two causes. The seriousness of the electric shock depends on the following factors.

(i) The Strength of Current: It has been experienced that in alternating currents of low frequency, the current between 1 mA and 8 mA are just bearable but the current between 8 mA and 15 mA gives a painful shock which sometimes contracts muscles. If the current through the body is between 20 mA and 50 mA it may stop breathing and the current between 100 mA and 200 mA may cause fibrillation of the heart.

Thus it is seen that it is the current which gives shock although it depends upon the voltage. The current through the body is given by I=V/R where V is the supply voltage and R is the body resistance.

The body resistance is different under different conditions. When the body is dry, its resistance varies between 10,000 ohms and 100,000 ohms per sq. cm. But when the body is wet, its resistance reduces to between 700 ohms and 1000 ohms per sq. cm. The average resistance of the body may be taken as 50,000 ohms when dry and 1000 volts supply is as dangerous as 10,000 volts when the body is dry.

(ii) The Frequency of Current: The lower the frequency, the more dangerous is the shock and the direct current shock is the most severe.

(iii) Path of Current through Body: If the path of the leakage current does not involve the chest or the heart, survival is possible but there are severe burns on the parts of the body involved in the shock depending upon the value of the current.

Shock Treatment

Send for a physician immediately and start the following procedure. In most of the cases the electric shock due to accidents is momentary and the contact with the live wire is perfect which results in the stoppage of breath momentarily. But, if due to the shock the victim becomes unconscious and stops breathing, his heart still beats and the most urgent and immediate cure for this victim is to give him artificial respiration till he starts breathing normally. It should be borne in mind that if the artificial respiration is stopped just after the victim becomes conscious, he is liable to become unconscious again. In some cases the artificial respiration is to be continued for six to eight hours.

Artificial Respiration: At the time of accident due to electric shock proceed as follows:

(a) When anyone gets a shock, the first and foremost duty of the observer is to break the contact of the live mains and the body either by switching off the main supply or by rolling away the body with a dry wooden stick.

(b) Check up if the patient is breathing or not; if he is not breathing, immediately start artificial respiration as detailed below until medical aid arrives.

Lay the patient as shown in Fig 6.3. Kneel over the patient's back and place both the hands on his waist on the back near the lowest rib in such a manner that the fingers remain spread on the sides

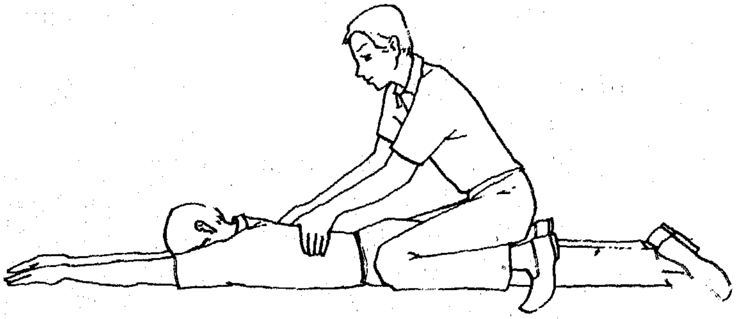

Fig. 6.3 ARTIFICIAL RESPIRATION

and the two thumbs almost touch each other.

(c) Now, press gradually and slowly for about five minutes by leaning forward with your hands. Relax the pressure slowly and come to the original kneeling position. Repeat the process 12-15 times in a minute. It expands and contracts the patient's lungs so as to initiate breathing. The process should be continued with great patience till the victim breathes normally.

Precautions against Shocks

It is always necessary to observe the following precautions against shock since prevention is better than cure:

(i) Try to avoid work on live mains. They should be switched off before starting the work.

(ii) If it is not possible to switch off the mains, be sure before working that your hands or feet are not wet.

(iii) In order to rescue a person who has got an electric shock if there is no other insulator available for rescue use your feet rather than hands.

(iv) When working on live-wire be sure that the floor is insulated with a dry wooden plank. Concrete floors are dangerously conductive.

(v) When working on live-wires try to keep your left hand in the pocket, *i.e.* avoid your left hand getting in contact with any live conductor or metalic casing of an apparatus.

(vi) Do not work in a place where your head is liable to touch the live mains before making the circuit dead.
(vii) Take care in handling electrical apparatuses and equipment.
(viii) Never use appliances etc. that are damaged or have frayed leads.
(ix) Replace immediately broken switches, plugs, etc.
(x) Check that all metal parts of an electrical equipment are effectively earthed.
(xi) Never place wires into the wall-plug without using a plug top.
(xii) Never tamper unnecessarily with any live apparatus.
(xiii) Check for proper working of safety devices.
(xiv) Periodic testing of insulation resistance of electrical appliances and equipment should be done to ensure safety.
(xv) Put dummy plug-tops in wall-sockets which are not in use.
(xvi) Follow operating instructions, while using appliances/equipment given by the manufacturer.

ACTIVITY 7

Time Required: Two Hours

Familiarization with Common Measuring Instruments

Objectives

- (i) To identify different electrical instruments.
- (ii) To enable students to select proper range of instruments.
- (iii) To understand the uses of the ammeter, voltmeter, multimeter and energymeter.

Related Information

While studying electricity, we come across a number of quantities such as current, potential difference, resistance, power, energy, etc. Each quantity has its own unit and there is an instrument for its measurement. Instruments can be classified into three groups: deflecting type, recording type and integrating type. There are some instruments which measure d.c. only; others measure both a.c and d.c. Again, there are portable instruments for laboratory use and panel mounting type instruments for fixing on control panels. Some of the common instruments used in the electrical field are ammeter, voltmeter, multimeter, watt-meter, energymeter, power-factor meter megger, ohm-meter, etc. Every instruments is designed for a particular range of operation. Thus, selection of proper range of instrument is very important in measurement.

Tools, Equipment and Materials Required

Tools

- (i) Big screw driver—8″
- (ii) Knife

Equipment

(i) Ammeter 0-5A
(ii) Voltmeter 0-250V
(iii) Multimeter
(iv) Energymeter
(v) Variable Resistance

Material

(i) (Connecting wires

Procedure

Take an ammeter of range 0-5A (Fig.7.1). This ammeter can read up to 5 amperes. Ammeter is an instrument used to measure current through the load. Ammeter is connected in series with the load as shown in (Fig. 7.2). Now, the circuit can be switched on by closing the switch and the meter indicates current through the resistance. The internal resistance of an ammeter is very low.

Select a voltmeter of range 0-250 V (Fig.7.3). Observe the scale carefully. It can measure voltage up to 250V. The A.C. voltmeter is an instrument used to measure voltage across two termi-

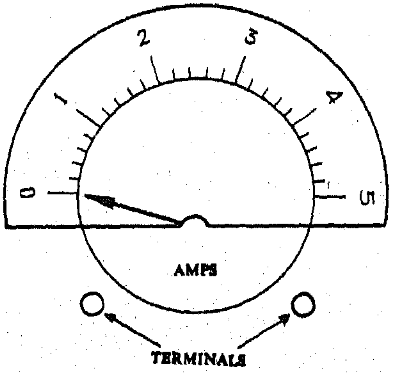

Fig. 7.1 AMMETER

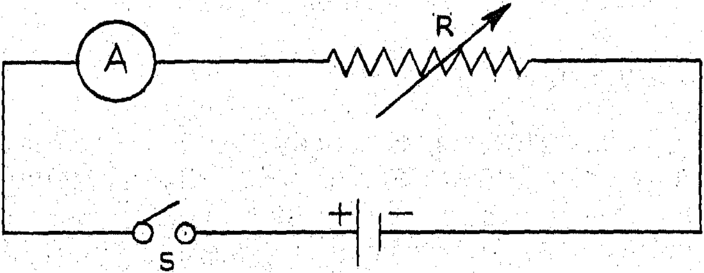

Fig. 7.2 MEASUREMENT OF CURRENT

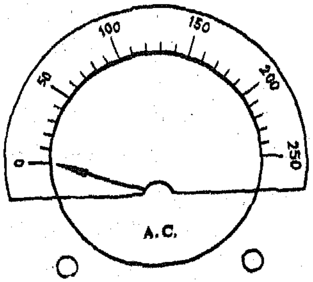

Fig. 7.3 VOLTMETER

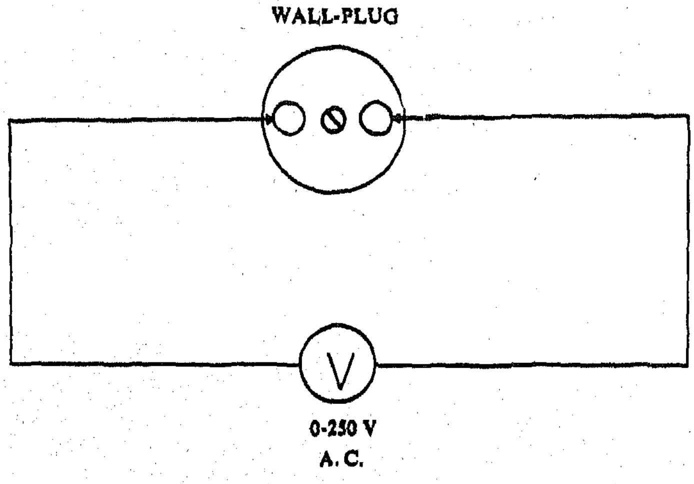

Fig. 7.4 MEASUREMENT OF VOLTAGE

nals. Fig. 7.4 shows how a voltmeter is connected in parallel to measure voltage. The voltage is read from the scale. The internal resistance of voltmeter is very high.

Take a multimeter and observe the scale and the selection switch for different ranges of voltage, current and resistance (Fig.7.5). It is used to measure voltage, current and resistance. Jacks are plugged into two corresponding holes in the meter and the probes are touched together for checking continuity and zero deflection. Then the probes are connected to two terminals of the supply and the meter indicates the supply voltage.

Now observe the energymeter (Fig. 7.6). You might have seen energymeter in your house. It records the energy consumed in a given period. There are four terminals, the first two for the supply and the last two for the load. The meter gives reading directly in the scale by recording.

Application

The ammeter is used for measuring current flowing through a device. It is connected in series with the load. The voltmeter is used to measure voltage of a given source or potential difference between two points. A multimeter is used for the measurement of current, voltage and resistance. The energy meter is used to record energy consumption in a given period.

Precaution

(i) Handle the instruments carefully as they are very sensitive for mechanical shock.

(ii) Select a suitable range of instruments before making connections.

(iii) Exercise great care while measuring high voltages.

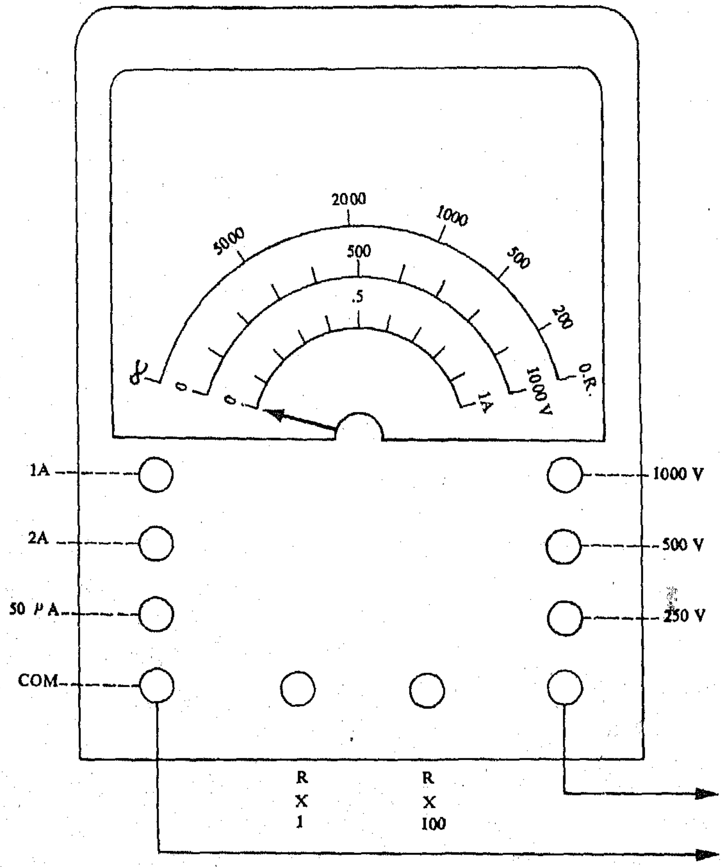

Fig. 7.5 MULTIMETER

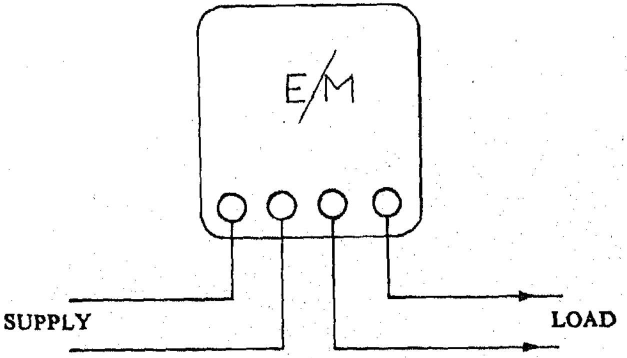

Fig. 7.6 ENERGY METER

ACTIVITY 8 *Time Required*: Three Hours

Familiarization with Wires and Cables

Objectives

(i) To emphasize the need and importance of wires.
(ii) To acquaint students with different types of wires.
(iii) To enable students learn about the use of wire-guage.
(iv) To develop understanding on the selection of wires and cables.

Tools, Equipment and Materials Required

Tools

(i) Insulated cutting pliers 20 cm : one
(ii) Knife with wooden handle : one

Equipment

(i) Wire gauge : one
(ii) Multimeter : one

Materials

(i)	3/20 PVC wire	0.5 metre
(ii)	7/20 PVC copper wire	0.5 metre
(iii)	3/20 PVC aluminium wire	0.5 metre
(iv)	7/22 PVC aluminium wire	0.5 metre
(v)	40/47 flexible twin twisted wire	0.5 metre
(vi)	3 Core flexible cable	0.5 metre
(vii)	7/20 weather-proof wire	0.5 metre
(viii)	7/20 two-core lead-sheathed cable	0.5 metre
(ix)	40/22 auto cable	0.5 metre

Related Information

Wires and cables carry power from the source to the consumer point. They are of different sizes and types for different applications. The wires are made of copper or aluminium conductors covered by an insulating material. The size of the conductor is so chosen that it conducts the maximum current drawn by the load (appliance, light, etc.). The materials used for insulating the conductors are plastic, rubber, cotton and other chemical compounds. The insulation has to withstand the heat developed by the passage of current. A wire-gauge is used to measure the standard wire-gauge-number of a conductor (SWG No.) to estimate the quantity of current it could safely carry. Wires are designed for different voltages and currents. For example, a wire can be used on 250V/660V for which it is designed.

Procedure

Take a piece of 3/20 PVC copper wire and observe it carefully. *There is an insulation around the* conductor. Remove the insulation at one end of the cable using a cutting plier and knife (Fig. 8.1). Note that there are three strands of copper conductor. Using a wire-gauge find the SWG No. It is 20 SWG. So a wire specified as 3/20 has 3 strands of conductors and the size of each strand is 20 SWG. It can carry a current of 7 amperes.

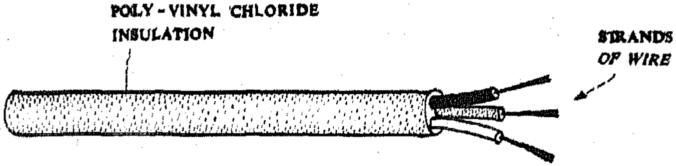

Fig. 8.1 PVC WIRE

Similarly, take a piece 7/20 copper wire. Remove the insulation at one end and record the number of strands and the gauge of the wire. A 7/20 PVC copper wire has 7 strands of 20 SWG and can carry a current of 12 amperes. Repeat the same activity for other cables. Copper wire is a better conductor than an aluminium wire. Aluminium cables, on the other hand, are cheaper than copper cables.

Twin-twisted flexible wires are available in diffe*rent sizes. Plastic/rubber* insulation is provided and two wires are twisted and run in length and rolled over a circular bobbin. The number of strands varies from 15 to 64 and the gauge of each strand varies from 26 to 40.

√ Vulcanized India Rubber Cables (VIR) are also in sue in house wiring. It has good insulation properties and high mechanical strength. Set the multimeter for resistance measurement and check the continutiy of wire.

In lead-sheathed cable the two wires are insulated with rubber and it is completely by protected with lead sheath to provide good mechanical safety (Fig. 8.2).

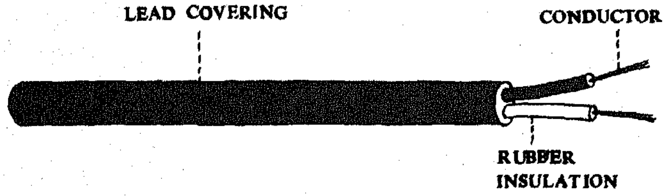

Fig. 8.2 LEAD-SHEATHED WIRE

Weather-proof wires are manufactured for applications where the cable is to withstand high temperature and moisture under varying climatic conditions.

Application

PVC and VIR cables are used for interior wiring of lighting, heating and power circuits. Flexible wires are used for pendent holders, temporary lighting, extension of wall plugs, etc. Three core cables are used for connecting electrical appliances and for providing temporary supply for three phase circuits. Weather proof wires are used out-doors.

Precaution

Select proper wire for a specific use. The 3/20 wires are used for lighting circuits and the 7/20 PVC/VIR wires are used for heating and power circuits up to 5 hp. Never pass more than the rated current through the wires.

ACTIVITY 9

Time Required : Three Hours

Familiarization with Electrical Accessories used in House-wiring

Objectives

(i) To acquaint students with electrical asscessories used in house-wiring.

(ii) To identify various types of electrical fittings.

(iii) To develop understanding of specification of accessories and their selection.

Related Information

A sound knowledge of the electrical accessories and fittings is very important for satisfactory and trouble-free service. The quality of goods plays a significant role in this direction. Electrical accessories are very delicate and require great care in handling them. Every accessory is specified with maximum current and working voltage. For example, switches, holders, wall plugs, etc., are rated at 5A, 250V for lighting circuits. The main switches are normally rated at 30A, 250 volts. The domestic installation specification implies the detailed information of an accessory regarding current-carrying capacity, working voltages, type, shape, make, size, etc. While buying an accessory, say a lamp, full details should be given: 60 watts, 250 volts, clear/milky and the make. Complete specification will help the dealer to supply what is actually desired.

In addition to electrical accessories like switches, holders, wall plugs, indicators, wires etc. used in house-wiring, a large number of fittings like water-tight fittings, bulk-head fittings, foot-lights, tube-light fittings, etc., are installed for illuminating the building.

Tools, Equipment and Materials Required

Tools

(i)	Connector screw-driver	7.5 cm : one
(ii)	Big screw-driver	15 cm : one

Instruments

(i) Multimeter : one

Materials

(i) Brass batten holder.
(ii) Pendent brass lamp holder.
(iii) Plastic batten holder.
(iv) Pendent plastic lamp holder.
(v) Two-pin wall plug.
(vi) Three-pin plug.
(vii) Two-pin plug top.
(viii) Three-pin plug top.
(ix) Single pole switch.
(x) Two-way switch.
(xi) Double pole switch.
(xii) Distribution box.
(xiii) Watertight fitting.
(xiv) Bulk head fitting.
(xv) Fluorescent tube fittings.
(xvi) Neon indicators.

Procedure

All the aforesaid accessories are to be displayed in the regular practical class. Opportunity should be provided to each student to observe, analyse, test, draw and record all information pertaining to each of the electrical accessories mentioned above. Adequate time should be given to each student to acquaint himself with the names of these accessories. The students have to draw neat sketches of electrical accessories and these should be corrected by the teacher during the practical classes. Children should open each accessory and see its internal parts.

Application

Batten holders, both metallic and plastic, are used where the lamps are to be fitted on the walls. Sometimes angular batten holders are used instead of straight batten holders. Pendent lamp holders are used where the lamps are to be hung from the ceiling-roses fixed to the roof. Three-pin socket outlets are used for using portable fans, electric stoves, table lamps, etc. All lighting accessories are rated 5A/250V while heating circuit accessories are rated 15A/250V. 15A wall plugs are used for hot plate and boiler connection. A 30A double pole switch with neon indicators for each of the lighting and heating circuits is used.

Fluorescent tube-light fittings are widely used to illuminate rooms, passage, kitchen, bedrooms where good day-light is preferred. Bulk head fittings are commonly used for illuminating the surrounding areas of the front and rear doors. In addition, decorative light/fancy light fittings are installed for show.

Precautions

(i) Handle electrical accessories and fittings with great care.
(ii) Connections to the terminals should be tight enough to avoid loose contact.
(iii) All wall fittings should be mechanically secured to the wall.
(iv) Never plug a hotplate to a lighting plug-point.

ACTIVITY 10

Time Required : Three Hours

Uses of Switches and Fuses and Their Placement in Wiring

Objectives

(i) To develop skill and knowledge for connecting fuses and switches in wiring circuits.

(ii) To develop knowledge and skill for the placement of fuses and switches in wiring circuits.

Related Information

A switch is used to make or break an electric circuit. It should be operated so that it makes the circuit firmly, and under some abnormal conditions it retains its rigidity and keeps its alignment between the switchblade and the contact correct to a fraction of a centimetre. At the instant of break there is formation of an arc, that burns or damages the contact. To avoid this, a spring is provided to move the blade for quick operation. The switches must have high insulation resistance. Types of switches are surface switch, flush switch, pull switch, grid switch, rotary snap switch, push button switch, ironclad watertight switch, knife switch, etc.

The fuse is a safety device or a wire of metal in a cutout which may be fused by an excessive current. The current drawn by an appliance is restricted by the resistance in the circuit. In case of short circuit the resistance decreases so that the flow of current increases. This current produces heat in the circuit and burns the equipment or the connecting wire. Therefore a fuse is provided in the circuit, which breaks after the value of the current increases beyond its normal current rating and thereby faulty circuit is disconnected. The fusing elements are lead-tin and tinned copper. The lead-tin alloy fuse is not used beyond the 10-ampere range for which the copper wire is suitable.

The fuse elements are placed in fuse-holder which is designed keeping in view insulation and separation of terminals, security against fire and ease for replacement.

The design of a fuse depends on its use and the nature of work. The types are semiclosed and totally closed. The semiclosed one is used in houses. In this type the fuse element is kept neither opened nor closed. The removable holder which carries the fuse, is called fuse-carrier. The part which carries the fixed contacts with the terminal wire is called fuse-base. In the totally enclosed fuse the element is placed in an insulating container called cartridge. It is in the form of a tube and the ends are enclosed in metallic caps and filled with quartz powder to increase the minimum fusing current. (Fig. 10.1)

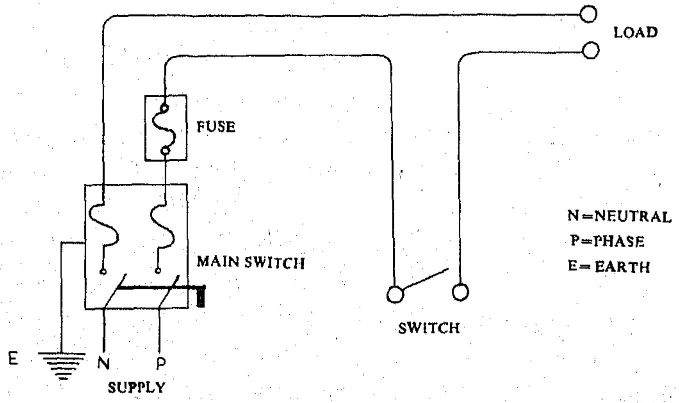

Fig. 10.1 PLACEMENT OF SWITCH AND FUSE IN CIRCUIT

Tools, Equipment and Materials Required

(i) Different types of switches.
(ii) Different types of fuses (semiclosed and closed).
(iii) Various guage of copper and lead tin fuse.
(iv) Line tester.

Procedure

(i) Open and study and different parts of various switches.
(ii) Study the use of parts and their working.
(iii) Open and study different types of rewirable fuse unit.
(iv) Open and study a cartridge fuse unit.

(v) Connect the fuse always to the supply live wire (phase) and not to the netural.

(vi) Place the switch connection always on phase.

Precautions

(i) Place the switch and the fuse on phase line.

(ii) For replacing the fuse element, take a correct length.

Application

(i) A switch is required to control or operate electrical devices.

(ii) A fuse is essential for safety of appliances and wiring.

ACTIVITY 11

Time Required : Two Hours

Selection, Fixing and Wiring a Fuse

Objectives

(i) To study the melting-points of various metals.
(ii) To know the current rating of various fuse wires such as copper, aluminium, lead-tin.
(iii) To study the replacement of a fuse wire.
(iv) To study the various types of fuse unit.

Related Information

The required size of the fuse wire depends upon the circuit current. A fuse is a means to protect an electrical circuit from drawing excess current. If by any means a fault develops in the electric circuit it would draw large current thereby overheating the conductor and damaging electrical equipment, wire, etc. The purpose of the wire is to carry normal working current safely but if the current exceeds, it should heat up to the melting-point. Lead and tinned copper fuses are used for small current while copper wire is used for large current (Fig. 11.1).

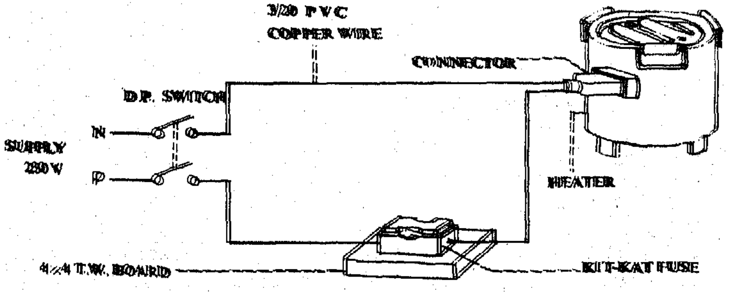

Fig. 11.1 CONNECTION OF FUSE IN CIRCUIT

Lead-tin Alloy Fuse Wire

SWG	*Fusing Current in Amperes*
25	3
24	3.5
23	4
22	5
21	6
20	7
18	10

Tinned Copper Fuse Wire

SWG	*Fusing Current in Amperes*
34	8.6
33	9.8
32	11.0
30	13.5
28	17
26	22
24	30
22	41

Tools, Equipment and Materials Required

(i) Combination pliers 15 cm
(ii) Screw-driver 10 cm
(iii) Electrician knife
(iv) Heater 1000 watt, 230V with connector
(v) Porcelain kit-kat fuse 15 A, 230 V
(vi) Fuse element 40 SWG and 35 SWG tinned copper wire.
(vii) 3/20 PVC copper wire 4 metres.
(viii) 4"×4" T.W. Board : one
(ix) Wooden Screw 25 mm

Procedure

(i) Fix the kit of the fuse unit on T.W. Board 4'' × 4'' by wooden screw.

(ii) Remove the insulation of 3/20 PVC copper wire to connect kit of the fuse unit to the phase terminal of the supply.
(iii) Connect the other end of the kit-kat unit to heater connector through 3/20 PVC wire.
(iv) Connect the other terminal of the connector to neutral terminal of the supply through 3/20 PVC wire.
(v) Fix the connector to the heater.
(vi) Fix the fuse element 40 SWG to a kat of fuse unit by unscrewing and screwing the knife terminal.
(vii) Switch on the supply.
(viii) Observe the fuse blow.
(ix) Replace the fuse element 35 SWG.
(x) Observe the fuse.

Precaution

(i) Connect the fuse only to phase.
(ii) Disconnect supply while replacing a fuse wire.

Application

Due to the short circuit and overload the fuses are burnt out, otherwise abnormal current damages the equipment and the connecting wires.

ACTIVITY 12

Time Required : Two Hours

Cutting of Wires and Removing Insulation

Objectives

(i) To study various types of insulation.
(ii) To study various types of insulated conductor.
(iii) To remove insulation of wires.

Related Information

The wires used for house-wiring are VIR (Vulcanized Indian Rubber) wire, CTS or TRS (Cab Tyre Sheathed or Tough Rubber Sheathed), lead sheathed wire, PVC (poly vinyl chloride) wire, weather proof wire and PVC flexible wire. The rubber covered taped wire is always single core. All other types of wires are single core, double core or three core. The VIR wire is used in cleat wiring, casing capping and conduit wirings. This wire is moisture-proof because cotton tape sheathed covering is provided with bitumen compound, wax or some other insulating materials for moisture proofing. In the CTS or TRS wire the conductor is provided with rubber insulation, over the insulation tough rubber sheath is provided for protection against wear and tear. The lead sheath wire is moisture-proof. The PVC insulation is harder than rubber. It gives good moisture proof without cotton taping and good mechanical protection.

Tools, Equipment and Materials Required

(i) Combination pliers 15 cm.
(ii) Electrician knife.
(iii) 1/18 PVC insulated copper wire 10 cm long.

Procedure

(i) Hold the combination pliers by the right hand.
(ii) Place the given wire between the cutting edge of the pliers (Fig. 12.1).

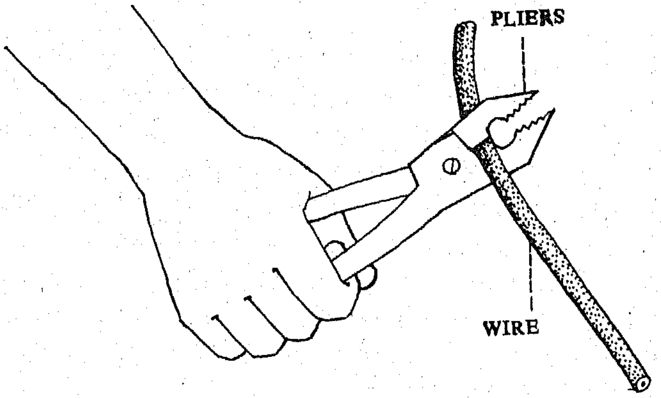

Fig. 12.1 CUTTING OF WIRES

(iii) Press the pliers handle for cutting the wire.
(iv) Hold the wire in the left hand and place a knife on the wire (with the same angle as for sharpening a pencil) and make cuts of round shape (Fig. 12.2).

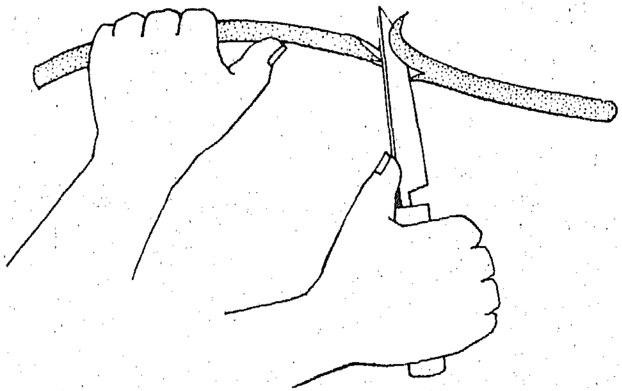

Fig. 12.2 CUTTING OF INSULATION

(v) Hold the cut portion of insulation by the pliers and pull it (Fig. 12.3).

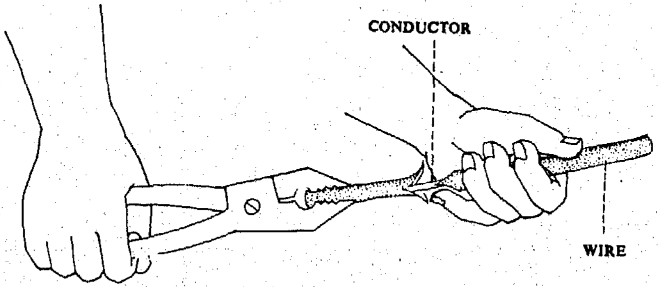

Fig. 12.3 REMOVING INSULATION

Precaution

(i) The insulation of a given wire should not be cut by holding the knife at right angles to the conductor.

(ii) Use the tools without damaging the conductor.

(iii) While removing the insulation take care not to damage the conductor. Otherwise the cross-section area is decreased and there is a chance of breaking the conductor.

Application

At the time of making joint or connecting the accessories to the insulated wire, insulation of wires is removed.

ACTIVITY 13

Time Required : Three Hours

Jointing of Wires for House-wiring

Objectives

(i) To study the types of joint and their application.

(ii) To study the perfect joint to ensure a good electrical connection and prevent corrosion.

Related Information

A poor electric contact creates resistance to the current flow and produces heat at the connection and the insulation burns. Therefore (i) the joint should be mechanically strong, it should be of 95 per cent tensile strength and 100 per cent electrical continuity; (ii) the joint should be soldered; and (iii) the joint should be perfectly taped. The types of joint used in house-wiring are: (i) twist joint (pigtail joint), (ii) tap joint and (iii) Western Union joint.

Tools, Equipment and Materials Required

(i) Combination pliers 15 cm.

(ii) Electrician knife.

(iii) Emery paper.

(iv) 1/18 PVC insulated copper wire one metre.

(v) Insulation tape.

Procedure

Pigtail Joint

(i) Take two pieces of 1/18 PVC wire.

(ii) Remove 3 cm insulation from one end of each wire.

(iii) Clean the jointing surface by emery paper.

(iv) Cross the wire at a point near the insulation layer.

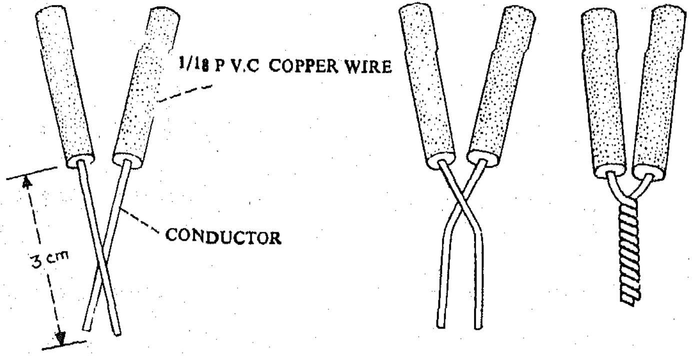

Fig. 13.1 PIGTAIL JOINT

(v) Hold the two ends of the conductor by a pliers and twist until tight.
(vi) Cut of the extra length of the conductor by the pliers.
(vii) Tape the joint by the insulation tape.

Tap Joint

(i) Take two pieces of *1/18 PVC* wire.
(ii) Remove 3 cm insulation from one end of one wire.
(iii) Remove 2 cm insulation of another wire at the place where the wire is to be joined.

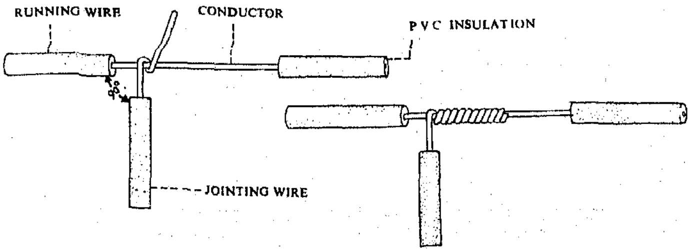

Fig. 13.2 TAP JOINT

(iv) Clean the conductors with the help of emery paper.
(v) Keep the jointing wire 90° on running wire and make a neck turn to avoid slipping of the joint.
(vi) Wrap the conductor closely and tightly by 6 to 8 turns on horizontal (straight) wire.
(vii) Cut off the excess wire.
(viii) *Twist the tap joint with pliers until tight.*
(ix) Tape the joint with the insulation tape.

Western Union Joint

(i) Take two pieces of 1/18 PVC wire.

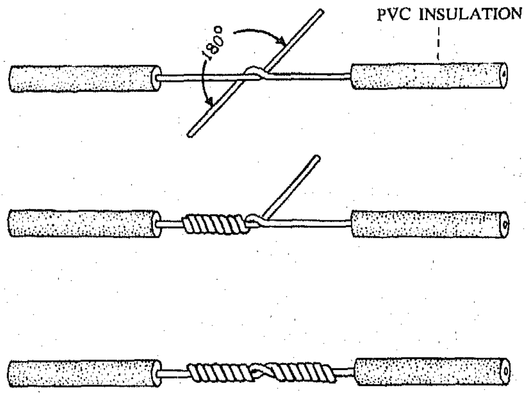

Fig. 13.3 WESTERN UNION JOINT

(ii) Remove 3 cm insulation from one end of each wire.
(iii) Clean the conductor by emery paper.
(iv) Place the wires straight touching each conductor face to face.
(v) Cross the conductor at a point about 1.5 cm beyond the insulation.
(vi) Twist the ends of the conductor at an angle of 180° to each other.
(vii) Wrap the ends of the wire around the other until the space is filled.
(viii) Cut off the excess wire.
(ix) Twist the western union joint with pliers until tight.
(x) Tape the joint with the insulation tape.

Precautions

(i) Insulation should be removed carefully without damaging the conductor.
(ii) Insulated wires should be handled gently for protecting insulation.

Application

(i) Pigtail joint is easy to connect the switch terminal. It is used when two conductors are parallel.
(ii) Tap joint is used where a wire needs to be joined at some point along another wire.
(iii) Western union joint is used where two wires under tension are joined to make a longer wire.

ACTIVITY 14

Time Required : Three Hours

Cutting, Joining and Fixing TW Batten

Objectives

(i) To mark the layout of the wiring.
(ii) Taking the measurement of the batten of required length.
(iii) Putting the batten of required shape on the layout.
(iv) Fixing of joint clips and fixing of the batten.

Related Information

In CTS wiring, insulated wires are held on wooden batten with help of link clips. This is suitable for damp climate, but cannot withstand much heat and is not suitable for hot weather and is prone to mechanical damage and fire. The width of the batten depends on the number of wires run on it. The shape of cutting depends on the layout of the wiring.

Tools, Equipment and Materials Required

(i) Tenon Saw.
(ii) Screw-driver.
(iii) Hammer 225 gms.
(iv) Firmer chisel 20 mm.
(v) Drill Machine.
(vi) Batten of 1.2 cm width and 100 cm length.
(vii) Screw 35 mm : 10
(viii) 3/4'' nails: 5.

Procedure

(i) Place the TW batten on the line.
(ii) Mark the length and the shape required.
(iii) If it is 90° angle drop, cut the opposite side of the TW batten in 1 cm curve downside (Fig. 14.1).

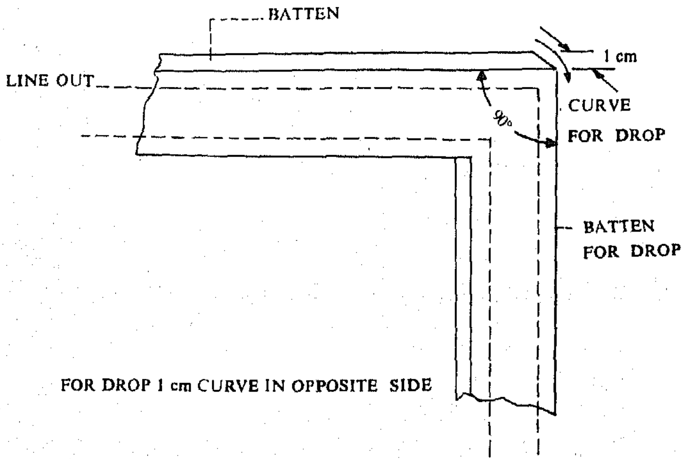

Fig. 14.1 PREPARING ANGLE FOR TW BATTEN WIRING

(iv) If it is Tee joint, one batten running on the line then another batten is placed on drop (Fig. 14.2).

(v) If it is straight line joint, cut the batten surface in V shape and other batten also in V shape to adjust same thickness with overlapping each other (Fig. 14.3).

(vi) If it is cross joint, place one batten on line and the other batten 90° to the line (Fig 14.4).

(vii) If there is wire crossing then make a bridge (Fig. 14.5).

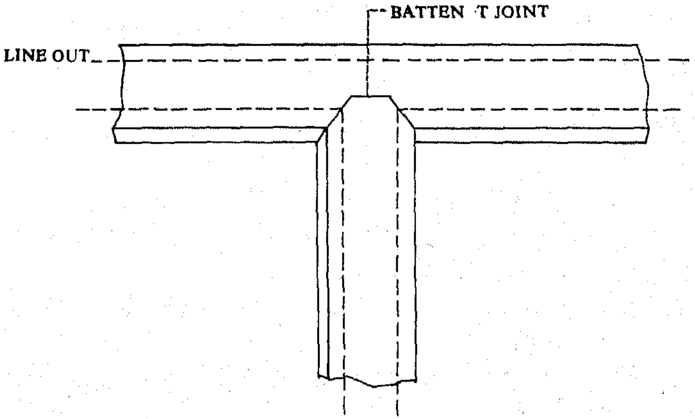

Fig. 14.2 TEE JOINT FOR TW BATTEN

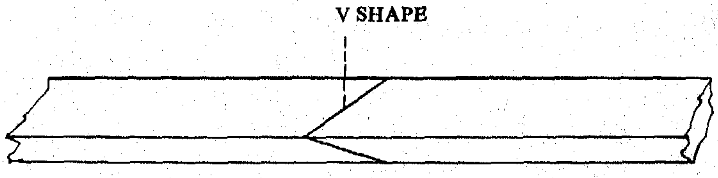

Fig. 14.3 STRAIGHT LINE JOINT OF TW BATTEN

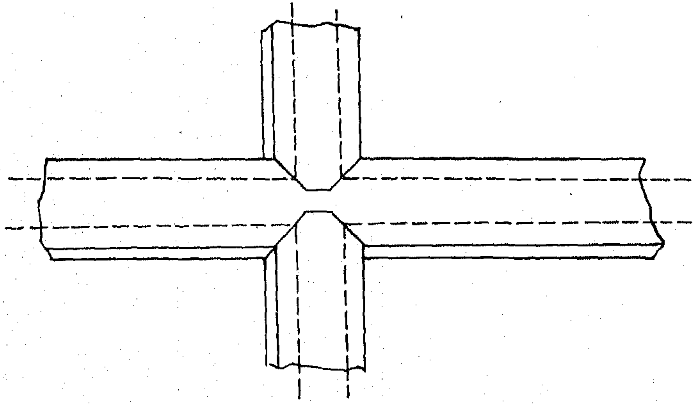

Fig. 14.4 CROSS JOINT FOR TW BATTEN WIRING

(viii) Cut the batten in slope when the portion of the wire to be inserted in a round block (Fig. 14.6).

(ix) In a Tee junction if all the wires are dropping down, cut the battens in slopes with opposite directions (Fig. 14.7).

(x) After cutting the batten for required size and shape, fix the joint clips at equal distances of 5 cm from each other with wire nails by hammering.

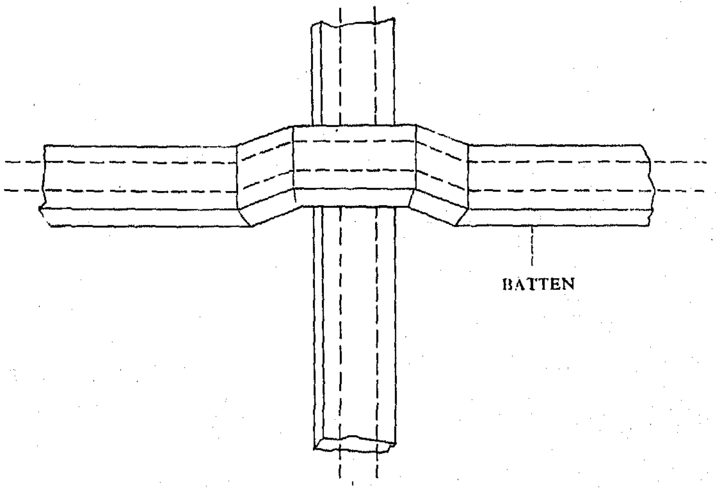

Fig. 14.5 CROSS BRIDGE JOINT FOR TW BATTEN WIRING

(xi) Drill holes on the batten and fix the batten on the wall with a screw of 30 mm size.

(xii) Cut the CTS wire of the required lengths and fix them on the batten with link clips.

Precautions

(i) Mark the correct length of the batten at the time of cutting.

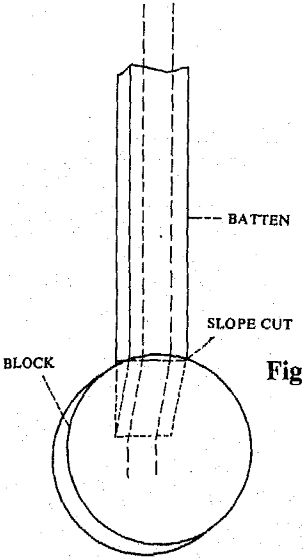

Fig. 14.6 FIXING ROUND BLOCK IN TW BATTEN WIRING

(ii) The corner edge of the batten should be rounded off so that the insulation may not be damaged.

Application

(i) The batten is used for CTS and TRS wiring.
(ii) Corner cutting is used where the wire turns 90° on the batten.

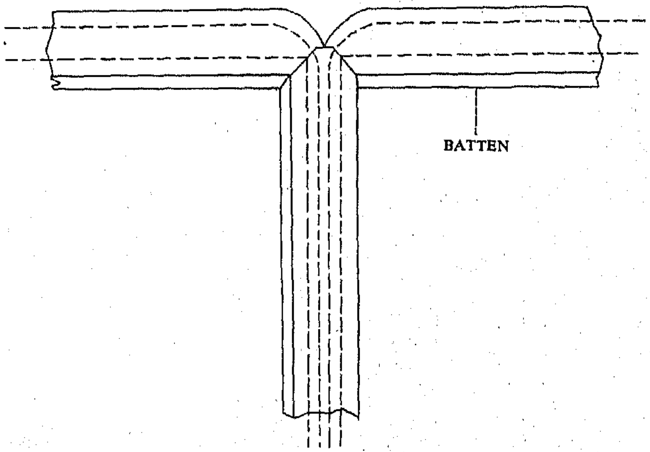

Fig. 14.7 DROP IN TW BATTEN WIRING

(iii) The Tee joint is used where one wire passes straight and the other drops at 90°.
(iv) The straight line joint is used to extend the batten on line.
(v) The cross joint is used where the wires meet the junction.
(vi) The cross bridge joint is used when wires overlap each other.

ACTIVITY 15

Time Required : Six Hours

Cutting, Joining and Fixing TW Casing and Capping

Objectives

(i) Marking casing and preparing straight joint.
(ii) Marking casing and preparing T-joint.
(iii) Marking casing and preparing corner joint.
(iv) Marking and preparing cross joint.
(v) Marking and preparing T-bridge joint.
(vi) Marking and preparing angle joint.
(vii) Marking and preparing bridge joint.

Related Information

The wood casing and capping consists of right angular wooden blocks made from seasoned teak wood. It has usually two groves into which the wires are laid. The top is covered by right angular strip of wood of the same width called capping and it is screwed to it. The VIR wire or PVC insulated wire is used. Casing is fixed with wood screw using rawlplug or *gutties on the wall or ceiling. Porcelain round* cleats should be used to keep the casing away from the wall. Casing and capping should be coated with varnish as a protection against dampness. For making joints skill in carpentry is required.

Tools, Equipment and Materials Required

(i) Tenon Saw 60 cm.
(ii) Screw-driver 20 cm.
(iii) Hammer 225 gms.
(iv) Firmer chisel 20 mm.
(v) Drill machine.
(vi) Try square.
(vii) Rasp file.

(viii) TW casing and capping 2 metres.
(ix) Wood screws 12 mm : 30.

Procedure

Straight Joint

(i) Take two short lengths of casing and capping each 20 cm long.
(ii) Mark a line with help of a pencil and try-square as shown in Fig. 15.1.

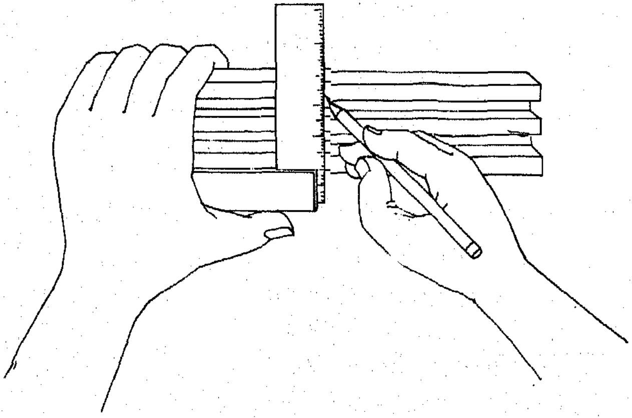

Fig. 15.1 MARKING CASING FOR STRAIGHT JOINT

(iii) Remove the portion as shown in Fig. 15.2.
(iv) Place one piece over the other as shown in Fig. 15.3.
(v) Make the joint permanent with a wooden screw and cover it with capping.

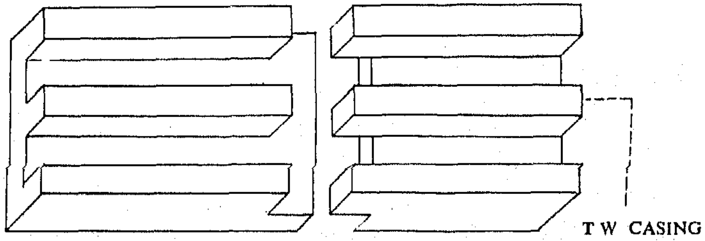

Fig. 15.2 CUTTING CASING FOR STRAIGHT JOINT

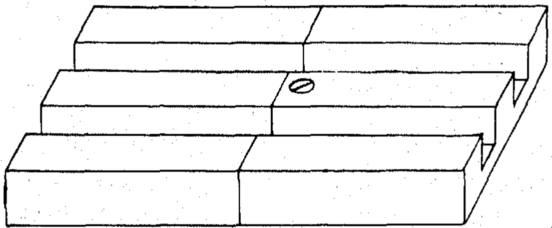

Fig. 15.3 JOINING CASING FOR STRAIGHT JOINT

Angle Joint

(i) Take two short lengths of casing and capping each 20 cm long.
(ii) Mark squares with a pencil on the two lengths of casing to be jointed.
(iii) Remove the cut portion as shown in Fig. 15.4.
(vi) Fix both the lengths one over the other as shown in Fig. 15.5.
(v) Fix the casing as shown in Fig. 15.6.

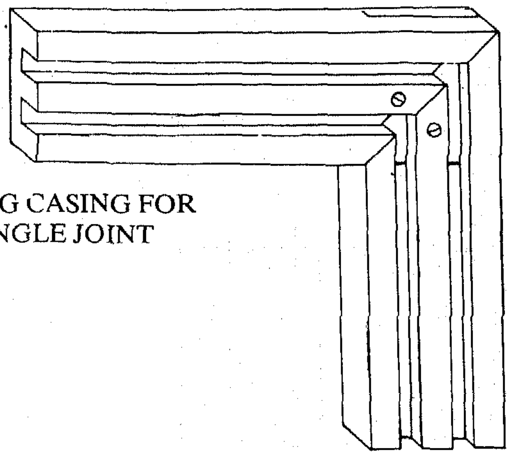

Fig. 15.5 FIXING CASING FOR ANGLE JOINT

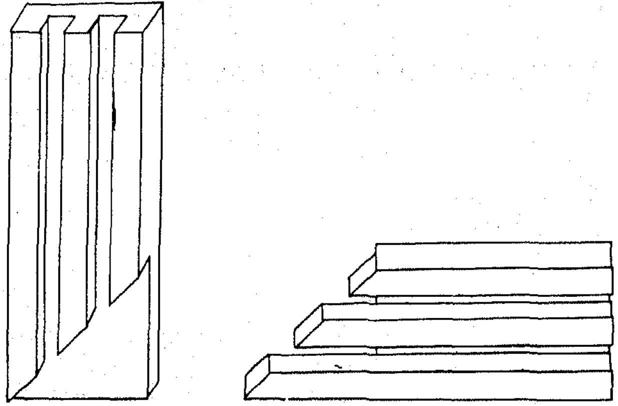

Fig. 15.4 CUTTING CASING FOR ANGLE JOINT

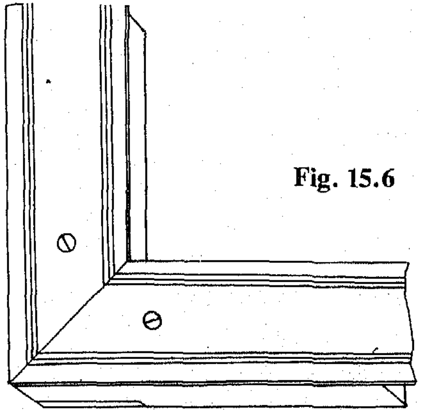

Fig. 15.6 FIXING CAPPING FOR ANGLE JOINT

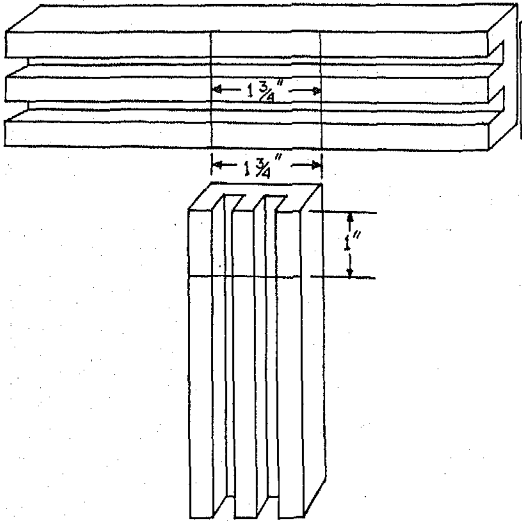

Fig. 15.7 MARKING CASING FOR TEE JOINT

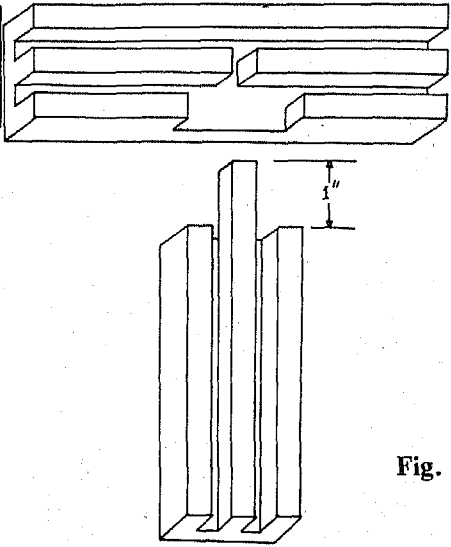

Fig. 15.8 CUTTING CASING FOR TEE JOINT

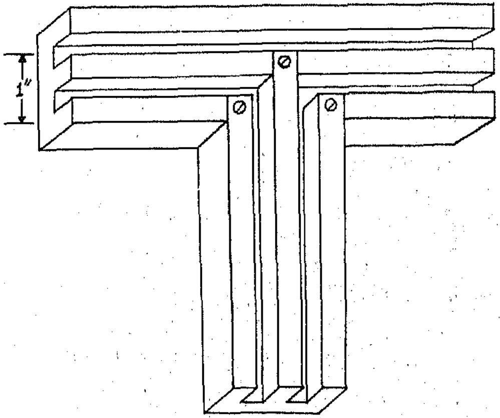

Fig. 15.9 FIXING CASING FOR TEE JOINT

Tee Joint

(i) Take two short lengths of casing and capping of 20 cm length.

(ii) Mark the portion as shown in Fig. 15.7.

(iii) Remove the portions which are not required as shown in Fig. 15.8.

(iv) Fix the joint with help of a screw as shown in Fig. 15.9.

(v) Cut and fix the capping as shown in Fig. 15.10.

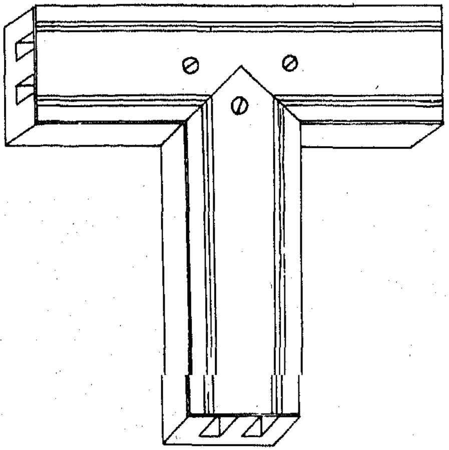

Fig. 15.10 FIXING CASING AND CAPPING FOR TEE JOINT

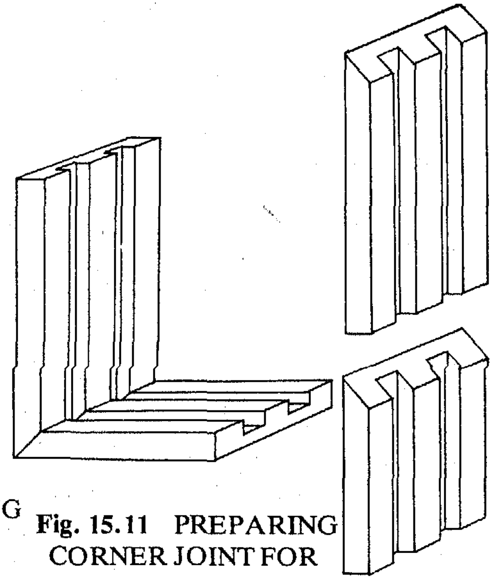

Fig. 15.11 PREPARING CORNER JOINT FOR WOOD CASING

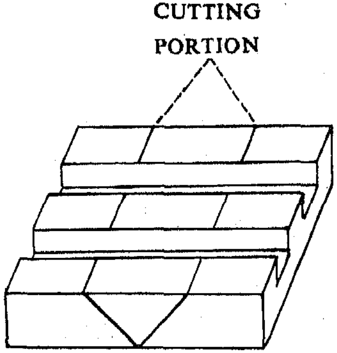

Fig. 15.12 CUTTING WOOD CASING FOR CORNER JOINT

Corner Joint

(i) Take two short lengths of casing and capping of 15 cm length.

(ii) Place both the lengths at right angle removing upper walls of one length equal to the thickness of the casing as shown in Fig. 15.11.

(iii) For marking the corner, a right-angled triangle is made on the casing as shown in Fig. 15.12.

(iv) Cut at an angle of 45° depth-wise.

(v) The joint is fixed in the right-angled joint as shown in Fig. 15.13.

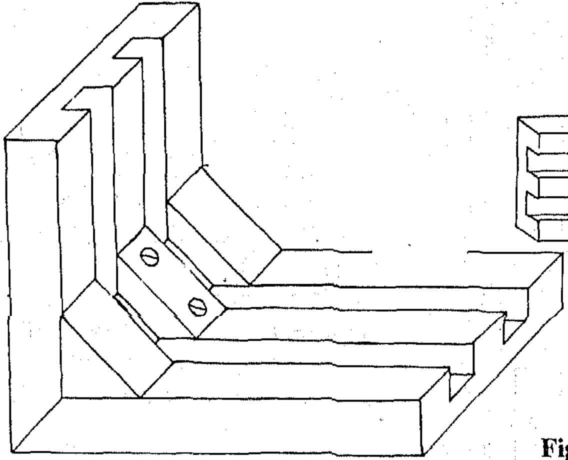

Fig. 15.13 FIXING CORNER JOINT FOR CASING AND CAPPING

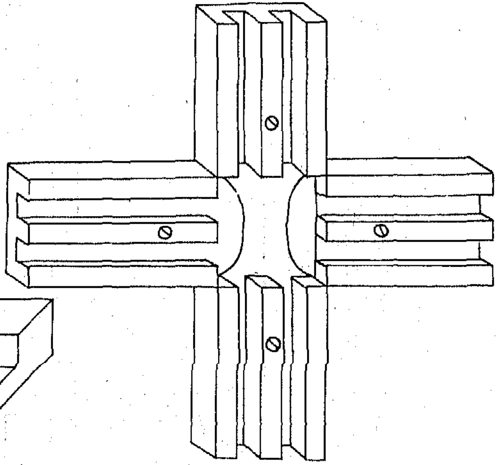

Fig. 15.14 PREPARING CROSS JOINT FOR CASING AND CAPPING

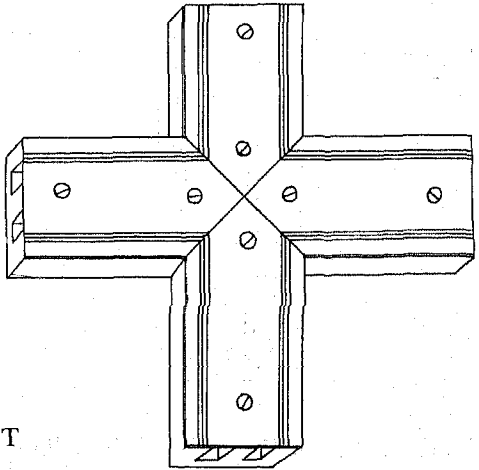

Fig. 15.15 FIXING CAPPING TO CROSS JOINT

Cross Joint

(i) Take two lengths of casing 20 cm each.

(ii) Make two Tee joints, one for the upper side and the other for the lower side as shown in Fig. 15.14.

(iii) The joint is covered with capping by screwing as shown in Fig. 15.15.

T-Bridge Joint

(i) Take two lengths of casing 75 cm for the bottom 'T' joint and 45 cm for the upper slope 'T' joint.

(ii) The bottom Tee and the upper Tee are made as shown in Fig. 15.9.

(iii) For making slope Tee joint cut the casing

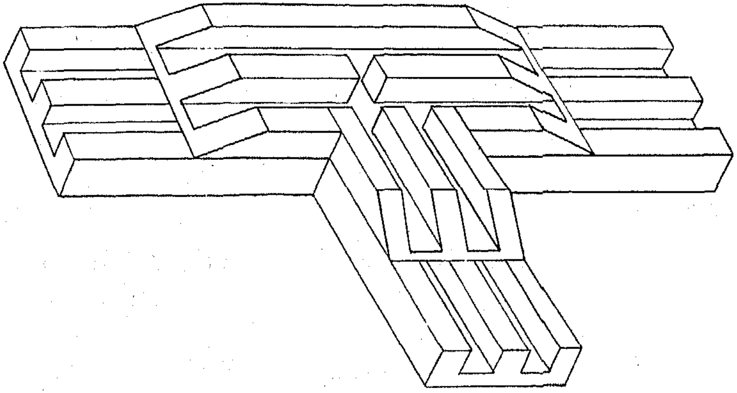

Fig. 15.16 PREPARING T-BRIDGE JOINT

into two pieces 30 cm and 15 cm long.

(iv) Remove the fillet portion of 30 cm length in sloping way from both ends and one end 15 cm length as shown in Fig. 15.16.

(v) Fix the sloped 'T' joint covering the other Tee joint with a 19 mm wood screw.

(vi) The joint is covered with capping by screwing as shown in Fig. 15.17.

Cross Bridge Joint

(i) Make bottom and upper cross joints as shown in Fig. 15.14.

(ii) Fix the sloped cross joint over the bottom cross joint.

(iii) The joint is covered with capping by screwing as shown in Fig. 15.18.

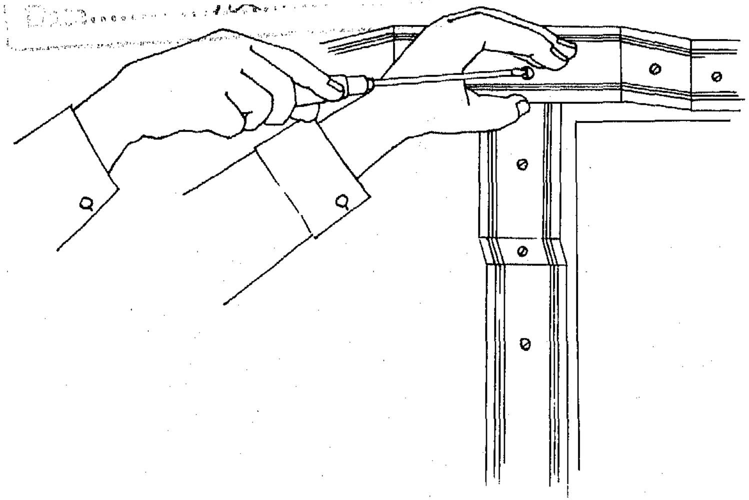

Fig. 15.17 FIXING T-BRIDGE JOINT

Fixing of Casing and Capping

(i) First fix the casing on the board as per the given route with proper joints.

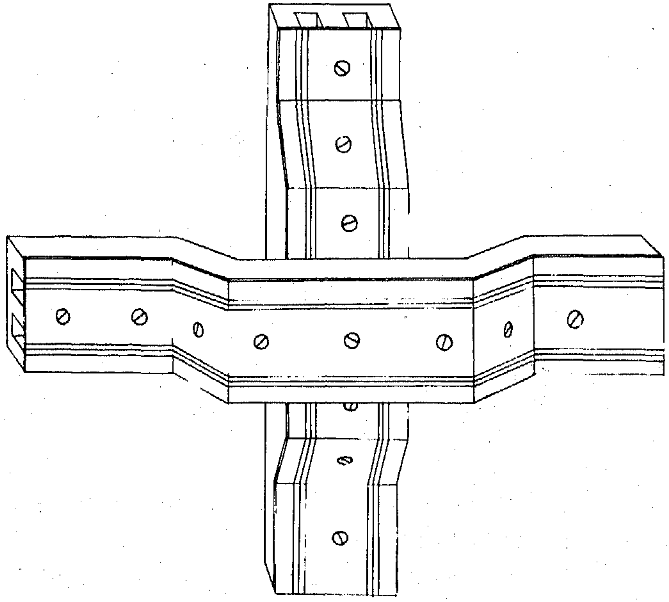

Fig. 15.18 PREPARING CROSS BRIDGE JOINT

(ii) Draw the VIR wire in the casing as per the circuit.
(iii) The casing is covered with capping using a 12 mm screw.

Precautions

(i) The firmer chisel should be used carefully so that it does not cut away the portion which is required.
(ii) There should be no gap between the joints.
(iii) For marking, a pencil and a try-square should be used.
(iv) The joint should be at right angle.
(v) At bends the corners should be rounded off so that the insulation may not be damaged.

Application

These joints are used in wood casing and capping wiring.

ACTIVITY 16

Time Required : Three Hours

Cutting, Joining and Fixing Conduit Pipe

Objective

To develop skill for cutting, threading and fixing conduit pipe.

Related Information

Conduit wiring is used for mechanical protection of wires. In this system the VIR wire is carried through a pipe. The types of conduits used for wiring are (a) screwed conduit, (b) flexible conduit, and (c) PVC conduit. Screwed conduit is a very good mechanical protection against moisture. The accessories are elbow, Tee, socket, bend and junction box. In the PVC pipe there is no threading. The accessories are fitted only by pressing. The PVC pipe has good insulation to earth than a metalic pipe. For fixing the pipe GI saddles are used.

Tools, Equipment and Materials Required

(i) Pliers.
(ii) Hacksaw.
(iii) Pipe die set 5/8''.
(iv) Screw-driver 20 cm.
(v) Hammer.
(vi) Drill machine.
(vii) Round file.
(viii) Pipe Wrench.
(ix) Conduit pipe 5/8'' diameter—two metres.
(x) 5'' conduit bend, Tee, junction box, etc.

Procedure

(i) Mark the pipe to required length.
(ii) Hold firmly in the pipe vice.
(iii) Cut it with hacksaw or pipe-cutter (Fig. 16.1, 16.2.)

(iv) The sharp edge of the pipe after cutting is filed by a round file.

(v) Fix die set on the pipe with required dimension for threading (Fig. 16.3).

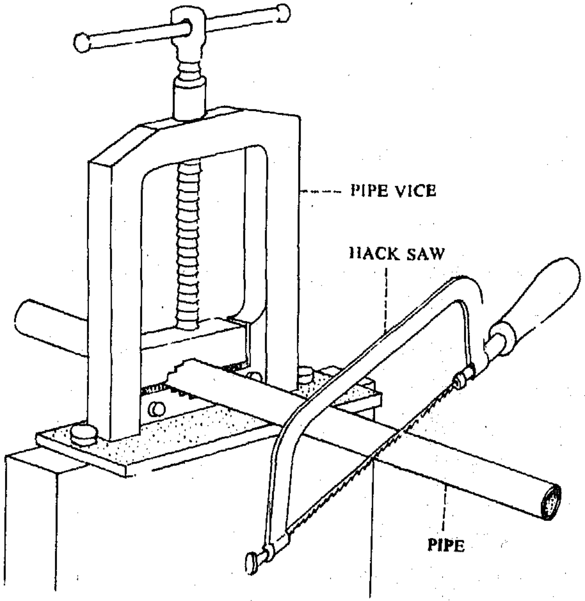

Fig. 16.1 CUTTING OF PIPE

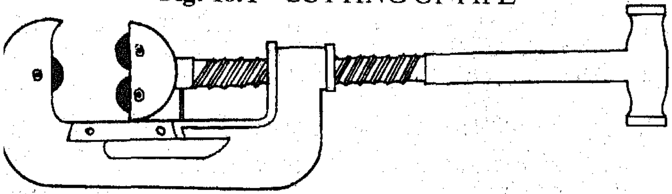

Fig. 16.2 PIPE CUTTER

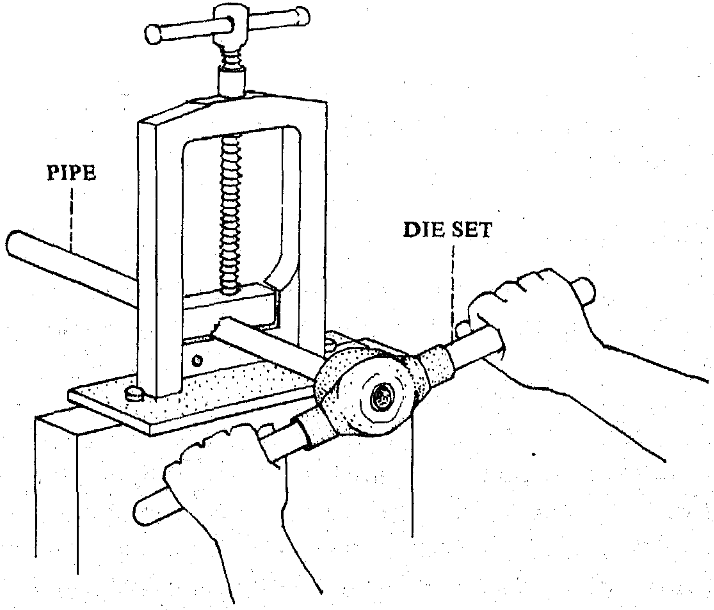

Fig. 16.3 THREADING OF PIPE

(vi) Give a number of cuts to the pipe by screwing and unscrewing the die set.
(vii) Use oil at the time of cutting and threading.
(viii) Fix the required pipe accessories to a pipe by a pipe wrench (Fig. 16.4).
(ix) Fix the conduit by means of saddles on the board or wall with junction boxes as required (Fig. 16.5).

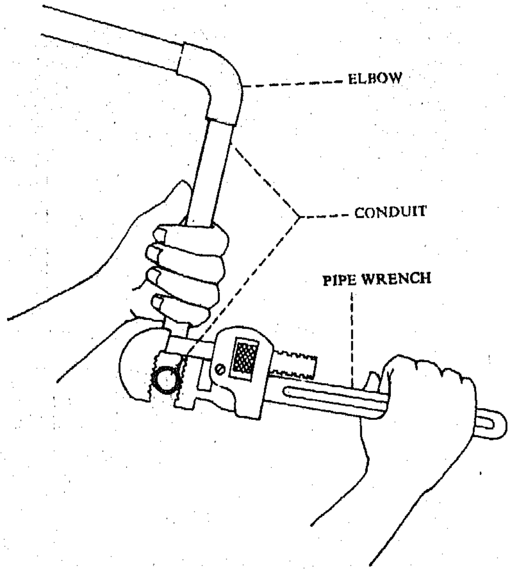

Fig. 16.4 PIPE FITTING USING PIPE WRENCH

Precautions

(i) The edge of the conduit should be filed before laying so that there are no sharp edges.
(ii) The conduits should be thoroughly cleaned and dried before laying.

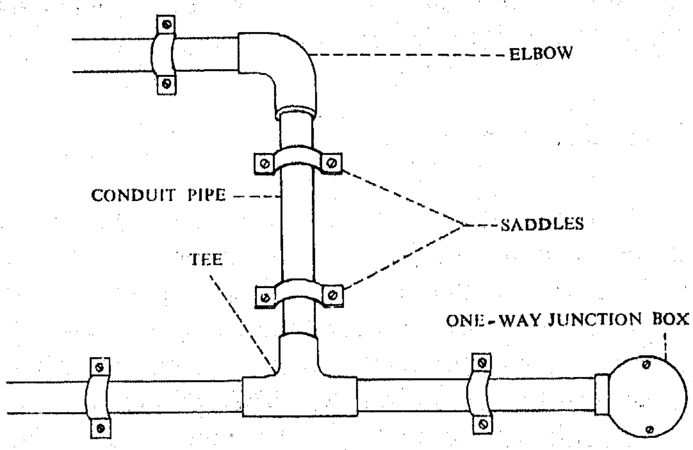

Fig. 16.5 LAYING CONDUIT PIPE WITH ACCESSORIES

ACTIVITY 17 *Time Required*: Four Hours

Wiring a Single Lamp and a Two-pin Socket in CTS/TRS

Objective

To make a circuit so that a lamp and a socket are controlled with their respective switches.

Related Information

A single pole switch (S.P. switch) is connected in series with a circuit for making or breaking it. Switch is connected in series with a lamp and another single pole switch is also connected in series with the socket. When the switch is on the circuit will be closed and lamp gives light. When the switch is off the circuit will be open and the lamp goes off. The same is the case with a socket when an electrical appliance is connected across the socket.

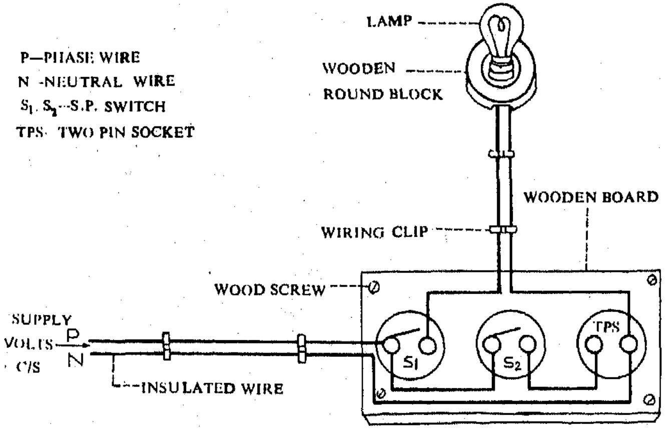

Fig. 17.1 A LAMP AND A 2-PIN PLUG WIRING IN CTS/TRS

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Wooden Board T.W.	10 cm × 17 cm	1
(ii)	Round Block T.W.	10 cm × 3 cm	1
(iii)	Wooden Batten T.W.	15 cm × 15 cm	1.5 metres
(iv)	Wiring Clips Tinned Copper	35 mm	30
(v)	One-way Tumbler Switch	5 amp, 230 Volts	2
(vi)	Two-pin Plug Socket	5 amp, 230 Volts	1
(vii)	Batten-holder Bakelite	5 amp, 230 Volts	1
(viii)	Wood Screws	20 mm × 6 mm	8
(ix)	Wood Screws	35 mm × 6 mm	6
(x)	Lamp	60 watts, 230 volts	1
(xi)	Series test lamp	60 watts, 230 volts	1
(xii)	PVC wire 1/18 SWG	1/8 SWG copper 1.5 mm aluminium	4 metres
(xiii)	Nails	15 cm	20 grams

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Insulated screw-driver	15 cm	1
(ii)	Insulated screw-driver	24 cm	1
(iii)	Insulated combination pliers	20 cm	1
(iv)	Electrician knife	15 cm	1
(v)	Poker	15 cm	1
(vi)	Hand Drill Machine	6 mm	1
(vii)	H.S.S. Drill Saw	5 mm	1
(viii)	Tennon saw	30 cm	1

Note:

(a) If the work is done on wooden wiring boards, the same material and tools as stated above are required.

(b) If the work is being carried out on wall, some additional materials will be required:

(i)	Wooden Gutties	5 cm × 3 cm × 3 cm	8
(ii)	Cold Chisel	3 cm	1
(iii)	Hammer Ball Pein	225 grams	1
(iv)	Cement/Sand as required for fixing the wooden gutties		
(v)	Porcelain cleats round	3 cm	6

Procedure

(i) Collect the required material and tools.

(ii) Mark the layout on the surface of a plank/wall.

(iii) Fix the batten as per the layout.

(iv) Fix the wiring clip at a distance of 10 cm on the batten.

(v) Fix the batten on the surface of the plank/wall.

(vi) Lay the wire on the batten through the clips.

(vii) Strip 1 cm insulation from the ends of the wire.

(viii) Place the accessories according to the circuit on the wooden board/round block.

(ix) Mark the mounting holes, connecting holes on the board.

(x) Make holes for connecting wires with 5 mm drill bit.

(xi) Make holes for fixing the accessories with a poker.

(xii) Mount all the accessories.

(xiii) Keep the board on the layout and make connections of the wires through the bottom of the accessories to the connection points. Tighten the connecting screws. Cover the accessories. Mount the board on the wall with wood screws.

(xiv) Check the circuit with the help of a series test lamp. Make connections with the supply.

(xv) Insert the lamp in the batten-holder and an electrical appliance across the socket. Put the switch on and check the working of the circuit.

Precautions

(i) Do not hammer the screw-driver.

(ii) Accessories should be mounted firmly.

(iii) Avoid loose connections.

(iv) The socket terminal holes and cover holes should be properly aligned.

ACTIVITY 18

Time Required : Four Hours

Wiring a Single Lamp and a Two-pin Socket in Casing and Capping

Objective

To make a circuit so that a lamp and a socket could be controlled with their respective switches.

Related Information

One single pole switch (S.P. switch) is connected in series with a lamp and another switch is also connected in series with the socket. When the switch is on, the circuit will close and the lamp gives light. When the switch is off the circuit will break and the lamp goes off. The same is the case with a two-pin plug socket when an electrical appliance is connected across the socket.

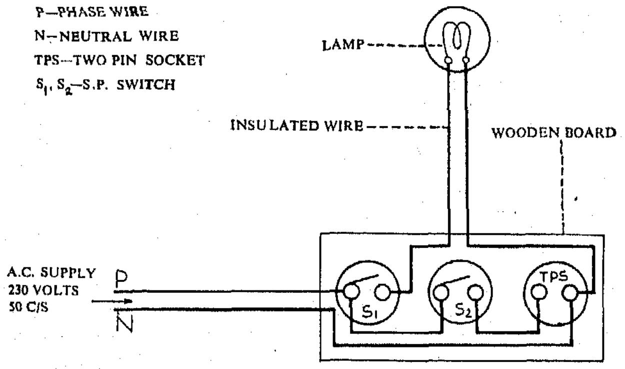

Fig. 18.1 A LAMP AND A 2-PIN PLUG WIRING IN CASING AND CAPPING

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Wooden Board T.W.	10 cm × 17 cm	1
(ii)	Round Block T.W.	10 cm × 3 cm	1
(iii)	Wooden Casing capping	35 mm × 15 mm	1.5 metres
(iv)	Wood Screws	12 mm × 6 mm	20
(v)	Wood Screws	20 mm × 6 mm	8
(vi)	Wood Screws	35 mm × 6 mm	6
(vii)	One-way Switch Tumbler	5 amp, 230 volts	2
(viii)	Two-pin plug socket	5 amp, 230 volts	1
(ix)	Batten holder Bakelite	5 amp, 230 volts	1
(x)	Lamp	60 watts, 230 volts	1
(xi)	PVC/VIR wire 1/18 SWG	1/18 SWG	4 metres
(xii)	Wooden Gutties	5 cm × 3 cm × 3 cm	6
(xiii)	Cement/Sand	as required	
(xiv)	Round Porcelain Cleats	3 cm	6

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Insulated screw-driver	15 cm	1
(ii)	Insulated screw-driver	25 cm	1
(iii)	Insulated combination pliers	20 cm	1
(iv)	Electrician knife	15 cm	1
(v)	Poker	15 cm	1
(vi)	Hand Drill Machine	6 mm	1
(vii)	HSS Drill	5 mm	1
(viii)	Tennon Saw	25 cm	1
(ix)	Firmer Chisel	15 mm	1
(x)	Rasp File	25 cm	1
(xi)	Cold Chisel	20 cm	1
(xii)	Ball Pein Hammer	225 gms	1

Procedure

(i) Collect the required material.
(ii) Mark the layout on the surface of a wood/wall.
(iii) Cut the casing and capping as per the layout.

(iv) Make the ends of the casing inclined with the help of a chisel.
(v) Fix the casing on the surface with the help of screws.
(vi) Lay the wire through the grooves of the casing.
(vii) Cover the casing with capping.
(viii) Fix the 12mm × 6mm screws in the centre of the capping to grip the casing from its centre.
(ix) Cut the wooden boards/round blocks with a saw and chisel so that the casing and capping may pass through.
(x) Fix the accessories on their respective boards.
(xi) After making the holes for wires and screws, strip 1 cm insulation from the ends of the wire.
(xii) Connect the ends of the wire, according to the circuit, through the bottom of the accessories into the connection terminal.
(xiii) Tighten the connecting screws.
(xiv) Cover the accessories with their respective covers.

(xv) Mount the wooden boards/round blocks on the surface.
(xvi) Insert the lamp in the holder and connect an electrical appliance across the socket.
(xvii) Connect the circuit to the supply.
(xviii) Check the circuit.

Precaution

(i) Do not hammer the screws/screw-driver.
(ii) Accessories should be mounted firmly.
(iii) Avoid loose connections.
(iv) The socket cover and the terminal holes should be aligned properly.
(v) Check the circuit before connecting to the main.

Applications

(i) Two-pin Plug Socket: An appliance whose current rating is 5 amp, 230V can be used in the socket.
(ii) The lamp is controlled through a switch.

ACTIVITY 19

Time Required : Five Hours

Wiring a Single Lamp and a Two-pin Socket in Metal Conduit (Surface)

Objectives

(i) To make a circuit so that a lamp and a socket could be controlled through their respective switches.

(ii) To know about the utility of using conduit pipe.

(iii) To be familiar with the sizes of conduit pipes and the different types of accessories.

Related Information

About Circuit

A single pole switch (S.P. switch) is used to control a lamp, another to control a two-pin socket. The function of both the switches for the lamp and the socket is to put the circuit on and off.

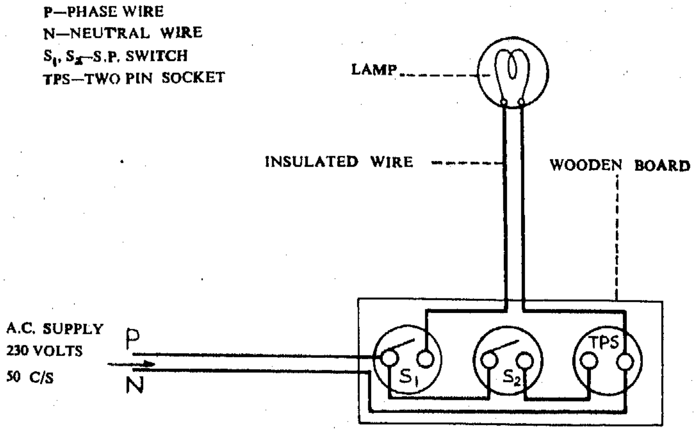

Fig. 19.1 A LAMP AND A 2-PIN PLUG WIRING IN METAL CONDUIT

About Conduit Pipes

Nowadays in house-wiring conduit pipe is used to minimize the possibilities of fire. Students will know how to cut the pipes, how to joint the pipes after making threads at the ends of the pipe. To draw the wire through the pipe is not so difficult. To keep the surface neat and clean the recessed wiring is done with the help of conduit.

In place of metal conduit we can use plastic conduit. Plastic conduit is cheaper than metal conduit. Instead of cutting threads as in the metal conduit, plastic pipe and its accessories are joined together with the help of plastic paste.

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Insulated Screw-driver	15 cm	1
(ii)	Insulated Screw-driver	25 cm	1
(iii)	Insulated Combination Pliers	20 cm	1
(iv)	Electrician Knife	15 cm	1
(v)	Poker	15 cm	1
(vi)	Hand Drill Machine	6 mm	1
(vii)	Drill HSS	5 mm	1
(viii)	Hacksaw Frame	30 cm	1
(ix)	Hacksaw Blade	30 cm	1
(x)	Bench vice		1
(xi)	Stock/Die	20/25 mm	1
(xii)	Tennon Saw	25 cm	1
(xiii)	Hammer Ball Pein	225 gms	1
(xiv)	Cold Chisel	15 mm	1

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Wooden Board T.W.	10 cm × 17 cm	1
	or Metal board		1
(ii)	Junction Box one way	19/20 mm one way	1
(iii)	Conduit Pipe	19/20 mm 16 SWG	2 metres
(iv)	Saddle	20 mm × 16 SWG	6
(v)	Batten Cleats	15 mm × 15 mm × 60 mm	6
(vi)	Wood Screws	15mm × 6 mm	12
(vii)	Wood Screws	20 mm × 6 mm	8
(viii)	Wood Screws	35 mm × 6 mm	6
(ix)	Rubber Bush	20 mm	4
(x)	Steel wire	14 SGW	2 metres
(xi)	One-way Switch Tumbler	5 amp, 230 volts	2
(xii)	Two-pin Plug Socket	5 amp, 230 volts	1
(xiii)	Batten-holder Bakelite	5 amp 230 volts	1
(xiv)	Lamp	60 watts, 230 volts	1
(xv)	PVC wire	1/18 SWG	4 metres
(xvi)	Oil		5ml
(xvii)	Machine Screws for holder	4 mm × 20 mm	2
(xviii)	Wooden Gutties	5 cm × 3 cm × 3 cm	4
(xix)	Cement/Sand	as required	

Procedure

(i) Mark the layout on the surface of wood/wall.
(ii) Fix the batten cleat to fix the pipe on surface.
(iii) Cut the conduit pipe according to the layout.
(iv) Fix the pipe on the pipe vice.
(v) Cut threads on both the ends of the pipe.
(vi) Fix the pipe on the cleats mounted on the surface.
(vii) Thread the junction box with the conduit pipe for lamp point.
(viii) Cut the board so that the pipe can pass through it.
(ix) Keep the switch and the sockets on the board.
(x) Mark the mounting holes and the holes for connecting the wires on the board.
(xi) Make holes with a drill machine on the board for wires.
(xii) Make guide holes for wood screw with the help of a poker.
(xiii) Mount the switches and the sockets on the board.
(xiv) Pass the PVC wires through the pipe with the help of a steel wire according to the circuit. Insert rubber bushes at the ends of the pipe.
(xv) Keep the board on the layout and connect the ends of the wire through the board into the connection terminal of switches and sockets as per the circuit.
(xvi) Cover the switches and the sockets.
(xvii) Mount the wooden board on the surface with the help of screws.
(xviii) Connect the batten-holder and mount it on the junction box with the help of a machine screw.
(xix) Check the circuit and connect it with the supply.
(xx) Insert a lamp in the holder and external load across the two-pin plug socket.
(xxi) Operate the switch and test the circuit.

Precaution

(i) Apply oil while cutting threads in the pipes.
(ii) Pipes should be fixed straight.
(iii) Use rubber bush before laying the wires in the pipes.
(iv) Avoid loose connections.
(v) The socket terminal holes and the cover holes should be aligned properly.
(vi) Accessories should be tight enough.

Application

(i) Two-pin plug: for extra connections.
(ii) The conduit pipe is used to minimise the possibilities of fire.

Time Required : Four Hours

Wiring a Single Lamp and a Two-pin Socket in Plastic Conduit

Objectives

(i) To make a circuit so that a lamp and a socket could be controlled through their respective switches.
(ii) To acquaint students with the difference between a metal conduit and a plastic conduit.
(iii) To acquaint students with different types of accessories of plastic conduit.

Related Information

A single pole switch (S.P. switch) is connected in series. A single pole switch is used to control a lamp and another to control a two-pin plug socket. The function of both the switches for the lamp and the socket is to put the circuit on and off.

The PVC (plastic) conduit is cheaper than a metal conduit. While fitting metal conduit more labour is required than in the case of 'plastic' pipe. In plastic pipe the accessories of the pipes can be joined simply by applying a paste. This pipe can also be used for recessed work.

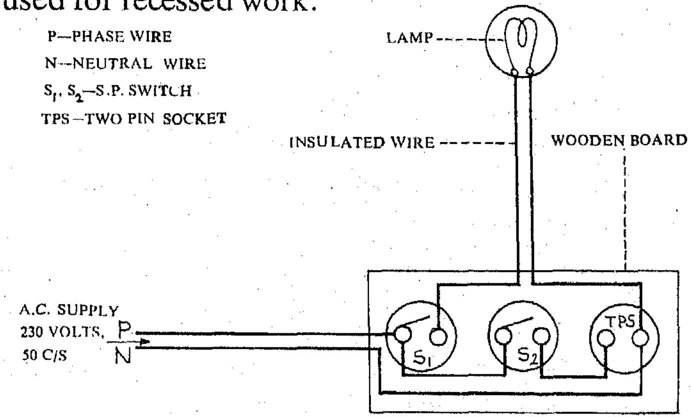

Fig. 20.1 A LAMP AND A 2-PIN PLUG WIRING IN PLASTIC CONDUIT

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Wooden Board T.W.	10 cm × 7 cm	1
(ii)	Junction Box one way—plastic	25 mm deep	1
(iii)	Plastic Conduit Pipe	19/20 mm	2 metres
(iv)	Saddle	20 mm 16 SWG	6
(v)	Batten Cleats	15 mm × 15 mm × 60 mm	6
(vi)	Wood Screws	15 mm × 6 mm	12
(vii)	Wood Screws	20 mm × 6 mm	8
(viii)	Wood Screws	35 mm × 6 mm	6
(ix)	Steel Wire	14 SWG	2 metres
(x)	One-way Switch Tumbler	5 amp, 230 volts	2
(xi)	Two-pin Plug Socket	5 amp, 230 volts	1
(xii)	Batten-holder	5 amp, 230 volts	1
(xiii)	Lamp	60 watts, 230 volts	1
(xiv)	PVC Wire	1/18 SWG	4 metres
(xv)	Machine Screws for Holder	4 mm × 20 mm	2
(xvi)	Wooden Gutties	5 cm × 3 cm × 3 cm	4
(xvii)	Cement/Sand	as required	

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Insulated Screw-driver	15 cm	1
(ii)	Insulated Screw-driver	25 cm	1
(iii)	Electrician Knife	15 cm	1
(iv)	Poker	15 cm	1
(v)	Hand Drill Machine	6 mm	1
(vi)	Drill HSS	5 mm	1
(vii)	Hacksaw Frame	30 cm	1
(viii)	Hacksaw Blade	30 cm	1
(ix)	Tennon Saw	25 cm	1
(x)	Hammer Ball Pein	225 gms	1
(xi)	Cold Chisel	15 mm	1
(xii)	Firmer Chisel	15 mm	1

Procedure

(i) Mark the layout on the surface of wall/wooden board.

(ii) Fix the batten cleats on the surface with the help of screws.

(iii) Cut the plastic pipe as per the layout.

(iv) Mount the pipes with the help of saddles on cleats.

(v) Paste the one-way junction box and fix the same on the layout.

(vi) Cut the board so that the pipe may pass through it.

(vii) Keep the accessories as per the circuit on the board.

(viii) Mark the mounting holes and the connecting holes of the accessories on the board.

(ix) Make holes with drill machine on the board for wire.

(x) Make guide holes for mounting the accessories on the board.

(xi) Mount the switches and the sockets on the board with the help of screws.

(xii) Pass the PVC wire through the pipe as per the circuit with the help of a steel wire.

(xiii) Strip 1 cm insulation from the ends of the wire.

(xiv) Keep the board on the layout, make the connection according to the circuit.

(xv) Cover the switches and the sockets.
(xvi) Mount the board on the surface with the help of wood screws.
(xvii) Make the connection of the batten-holder and mount it on the junction box with the help of machine screws.
(xviii) Check the circuit and connect it with the main supply.
(xix) Insert a lamp in the holder and external load across the socket.
(xx) Operate the switch and test the circuit.

Precautions

(i) Pipes should be fixed straight.
(ii) Avoid loose connections.
(iii) Accessories should be tight.
(iv) Check the circuit before connecting it to the main supply.
(v) The socket terminal and the cover holes should be aligned properly.

ACTIVITY 21

Time Required : Four Hours

Wiring a Single Lamp and a Two-pin Socket in Cleat-wiring

Objectives

(i) To develop skills for temporary wiring with porcelain cleats.

(ii) To make a circuit so that a lamp and a socket could be controlled with their respective switches.

Related Information

A single pole switch (S.P. switch) is connected in series with the circuit. A single pole switch is connected in series with the lamp and another switch is also connected in series with the socket.

When the switch for the lamp is put on the circuit will be closed and the lamp gives light. When the switch is put off the circuit will be open and the lamp goes off. The same is the case with a socket when an external load is connected across the socket.

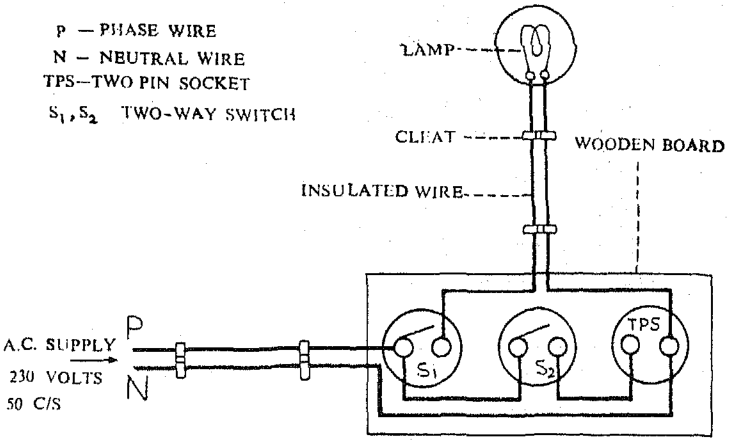

Fig. 21.1 A LAMP AND A 2-PIN PLUG WIRING IN CLEAT

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Wooden Board T.W.	10cm × 17 cm	1
(ii)	Round Block T.W.	10 cm × 3 cm	1
(iii)	Porcelain Cleats	Two-way	6
(iv)	One-way Switch Tumbler	5 amp, 230 volts	2
(v)	Two-pin Plug Socket	5 amp, 230 volts	1
(vi)	Batten-holder Bakelite	5 amp, 230 volts	1
(vii)	Wood Screws	20 mm × 6 mm	8
(viii)	Wood Screws	35 mm × 6 mm	9
(ix)	Lamp	60 watts, 230 volts	1
(x)	PVC/CTS wire	1/18 SWG	4 metres
(xi)	Wooden Gutties	5 cm × 3 cm × 3 cm	6
(xii)	Cement/Sand	as required for fixing the gutties	

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Insulated Screw-driver	15 cm	1
(ii)	Insulated Screw-driver	25 cm	1
(iii)	Insulated Combination Pliers	20 cm	1
(iv)	Electrician Knife	15 cm	1
(v)	Poker	15 cm	1
(vi)	Hand Drill Machine	6 mm	1
(vii)	MSS Drill	5 mm	1
(viii)	Tennon Saw	25 cm	1
(ix)	Firmer Chisel	15 mm	1
(x)	Cold Chisel	15 mm	1
(xi)	Hammer Ball Pein	225 gms	1

Procedure

(i) *Collect the required material and tools.*
(ii) Mark the layout on the surface of wall/wooden plank.
(iii) Mark the cleat point on the surface.
(iv) Fix the gutties on the wall or in the holes on the wooden surface.
(v) Place the porcelain cleat loose on the surface with screws.
(vi) Draw the wire through the cleat and tighten the cleat firmly.
(vii) Keep the accessories on their respective wooden board.
(viii) Mark the mounting holes and the connecting hole of the accessories on the board.
(ix) Make holes for wire with the help of hand drill machine.
(x) Make guide holes for wood screws with the help of a poker.
(xi) Mount all the accessories on their respective boards.
(xii) Keep the boards on the layout and cut the boards to pass the wiring through them.
(xiii) Strip 1 cm insulation from both the ends of the wire.
(xiv) Pass the ends of the wire through the bottom of the accossories andwooden boards

into the connection terminal as per the circuit diagram.

(xv) Tighten the connecting screws.

(xvi) Cover all the accessories.

(xvii) Mount the boards on the wood/wall surface.

(xviii) Insert the lamp into the holder. An external load (electrical appliance) is also connected across the socket.

(xix) Check the circuit and connect it with the supply.

(xx) Put the switches on and off and check the circuit.

Precautions

(i) Avoid sharp bend in the wires.

(ii) Wires should be right and straight through the cleats.

(iii) Keep the cleats 10 cm apart.

(iv) Accessories should be mounted firmly.

(v) Avoid loose connections.

(vi) The socket cover and the terminals should be properly aligned.

Applications

Cleat wiring is used for temporary connection for a low power consumption circuit.

ACTIVITY 22 *Time Required* : Four Hours

Wiring Staircase Light Controlled by Two Switches in CTS TRS

Objectives

(i) To know how one lamp could be controlled by two two-way switches located at two different places.

(ii) To develop skills in wiring a staircase lighting circuit.

Related Information

The function of all kinds of two-way switches is the same. One contact is a main contact and rest of the terminals are auxilliary contacts. The lamp is controlled independently by either of the switches. One can use one switch to put on the lamp and the other to put off the lamp and vice versa. The selection of switches depends upon the requirement of the place.

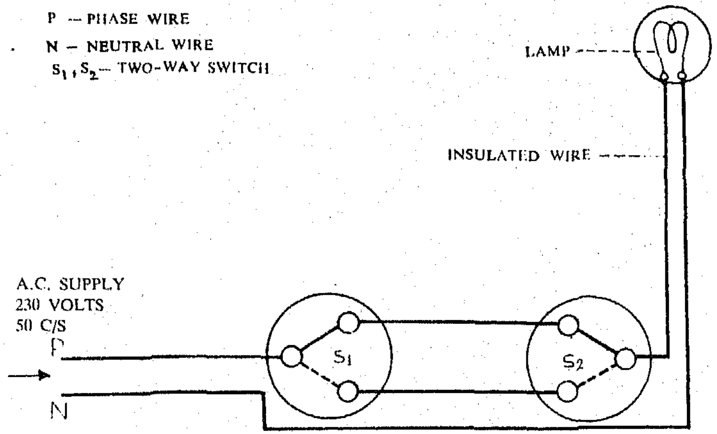

Fig. 22.1 STAIRCASE WIRING IN CTS/TRS

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Wooden Board T.W.	10 cm × 10 cm	3
(ii)	Two-way Switch Tumbler	5 amp, 230 volts	2
(iii)	Batten-holder Bakelite	5 amp, 230 volts	1
(iv)	Lamp	60 watts, 230 volts	1
(v)	Wood Screw	20 mm × 6 mm	6
(vi)	Wood Screw	35 mm × 6 mm	6
(vii)	PVC/CTS wire	1/18 SWG	6 metres
(viii)	Batten T.W.	15 mm × 15 mm	3 metres
(ix)	Wiring Clips	35 mm	20
(x)	Nails	15 mm	20 gms
(xi)	Wood Gutties	5 cm × 3 cm × 3 cm	6
(xii)	Round Porcelain Cleats	3 cm	6
(xiii)	Cold Chisel	3 cm	1
(xiv)	Hammer Ball Pein	225 gms	1
(xv)	Cement/Sand etc.	for fixing the gutties as required	

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Insulated Screw-driver	15 cm	1
(ii)	Insulated Screw-driver	25 cm	1
(iii)	Insulated Combination Pliers	20 cm	1
(iv)	Electrician Knife	15 cm	1
(v)	Firmer Chisel	15 mm	1
(vi)	Poker	15 cm	1
(vii)	Hand Drill Machine	6 mm	1
(viii)	HSS Drill	5 mm	1
(ix)	Hand Saw (Tennon Saw)	25 cm	1

Procedure

(i) Mark the layout on the surface of plank/wall.
(ii) Cut the batten according to the layout.
(iii) Nail the wiring clips on the batten 10 cm apart.
(iv) Mount the batten on the surface of plank/wall
(v) Lay the wire on the batten through wiring clips.
(vi) Strip 1 cm insulation from the ends of the wire.
(vii) Collect the accessories and place them on their respective boards.
(viii) Mark the mounting holes and the connecting holes of the accessories on the board.
(ix) Make hole for connecting wires with a drill machine and guide holes for wood screws with the help of a poker.
(x) Fix the accessories on their respective boards.
(xi) Keep the board on the layout and make the connection through the bottom of the accessories into the connection terminals. Tighten the connecting screws.
(xii) Mount the wooden boards on the surface.
(xiii) Insert the lamp in the holder.
(xiv) Give supply to the circuit and check the circuit by operating the switch.

Precautions

(i) Do not hammer the screws and the screwdriver.
(ii) Avoid loose connections.
(iii) Accessories should be mounted firmly.
(iv) Check the circuit before connecting it to the supply.

Applications

Staircase lighting is used in staircases, big rooms or passages where it is necessary to operate a lamp from two different points.

ACTIVITY 23 *Time Required* : Three Hours

Connection of a Fluorescent Tube in A.C. and D.C.

Objectives

(i) To identify tube starter, choke, condenser and its bleeder, (Discharge Resistance), holders, base.

(ii) To acquaint the students with different types of tube and testing of starter, choke, tube with the help of a series test lamp.

(iii) To develop skill in connecting fluorescent tube circuit to the supply.

Related Information

All the accessories, the choke, the starter and the tube, are connected in series. If a condenser is required in the circuit, that is connected across the supply in parallel to the tube circuit. A resistance called bleeder (discharge resistance) is connected across the condenser to discharge the condenser.

Tubes in different lengths and of different watts are available:

1500 mm/5 feet 80 watts 230 volts
1200 mm/4 feet 40 watts 230 volts
600 mm/2 feet 20 watts 230 volts
300 mm/1 foot 10 watts 230 volts

All the tubes operate on 230 volts and the circuit for all the tubes is the same.

The tubes are generally coated from inside with fluorescent powder and the colour of the tube, e.g. moonlight, daylight, depends upon the coated fluorescent powder.

The popularity of these tubes in the daily life is due to the reason that total illumination given out by them is much higher than that given by a filament lamp. The tubes operate at a low temperature.

The illumination of a 1200 mm tube is more than that of a 100 watt lamp. It is economical in respect of power consumption.

The circuit consists of a choke, starter, capacitor, fluorescent tube and a switch to operate the fluorescent tube.

When the switch is closed the supply voltage is applied across the starter through the choke and the tube. The normal supply voltage is sufficient to start a glow across the starter terminals for that period for which the glow persists, the tube filaments on its both ends are heated up. At the same time the glow across the bimetallic strips heat them up and so they are bent and the glow disappears i.e. the circuit will break. The sudden interruption of the current in the circuit causes high voltage (1000 volts) to appear across the tube filaments which is sufficient to start the discharge in the fluorescent tube. When the tube is illuminated the voltage across its terminals is about 110 volts. A condenser across the supply mains is for improving the power factor. A small condenser is connected across the two bimetallic strips inside the starter to suppress the radio interference generated by the lamp.

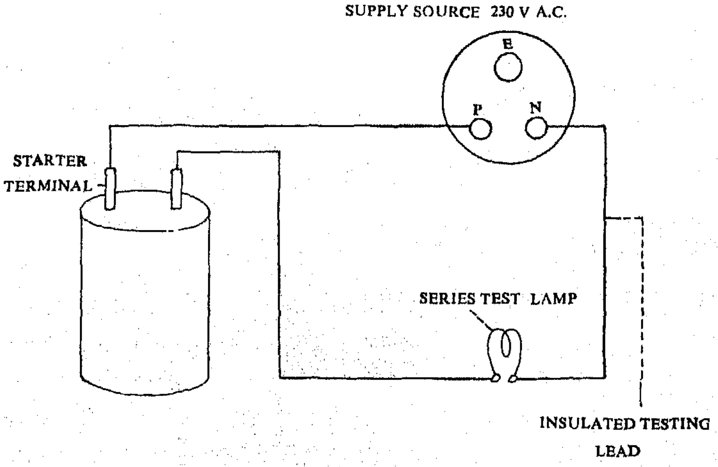

Fig. 23.1 TESTING A STARTER

How to Check a Starter

Connect a series test lamp in series with the starter. The lamp for testing should be of the same wattage as that of the starter or less than the wattage of the starter. If the starter is in working order the lamp connected in the circuit will blink and vice versa.

How to Check a Choke

Connect the series test lamp in series with the choke as shown in Fig. 23.2. The lamp used for testing the choke should be of the same wattage as that of the choke. If the tube is in working order the lamp will give dim light. If light is bright it means the choke is short. Hence it is defective. If there is no light in the lamp it means the choke is defective.

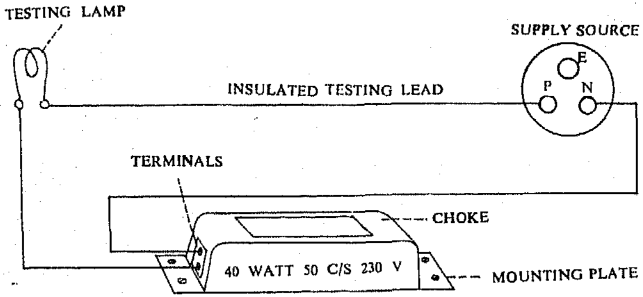

Fig. 23.2 TESTING A CHOKE

How to Check a Tube

Connect a series test lamp in series with one side's terminals of the tube. The testing lamp should be of less wattage than the wattage of the tube. If the lamp gives light it means the filaments of the tube are in working order. If the lamp does not glow, it means the tube is defective. Hence it is an open circuit. Repeat the same process for the second end of the tube.

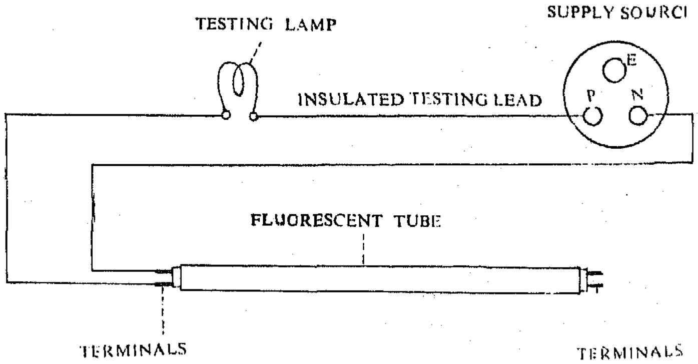

Fig. 23.3 TESTING A FLUORESCENT TUBE

Tools Required

S.No.	*Article*	*Specification*	*Quantity*
(i)	Insulated Screw-driver	15 cm	1
(ii)	Insulated Combination Pliers	20 cm	1
(iii)	Insulated Electrician Knife	15 cm	1
(iv)	Series Test Lamp	100 watts 230 volts	1

Materials Required

S.No.	*Article*	*Specification*	*Quantity*
(i)	Fluorescent Tube	40 watts 230 volts	1
(ii)	Choke	40 watts 230 volts	1
(iii)	Tube Starter	40 watts 230 volts	1
(iv)	Holder for Tube Starter	5 amp 230 volts	1
(v)	Tube-holder	5 amp 230 volts	2
(vi)	PVC Wire	1/24 SWG	3 metres
(vii)	Machine Screws with Nuts	3 mm × 20 mm	8

Procedure

(i) Collect the required materials and tools.
(ii) Mount the tube-holder and the starter-holder at their respective places.
(iii) Mount the choke on the base.
(iv) Cut the PVC wire according to the required size.
(v) Connect the wire as shown in the figure.
(vi) Insert the tube in the base.
(vii) Connect the circuit to the supply.
(viii) Put the switch on and the tube will glow. (See Figs. 23.4 and 23.5 on p. 85).

Precautions

(i) Handle the tube carefully.
(ii) Check the circuit, tube, starter, choke before putting in the circuit.
(iii) Save your hand from knife.
(iv) Do not apply excessive force while inserting the tube in the tube-holder.
(v) Avoid loose connections.

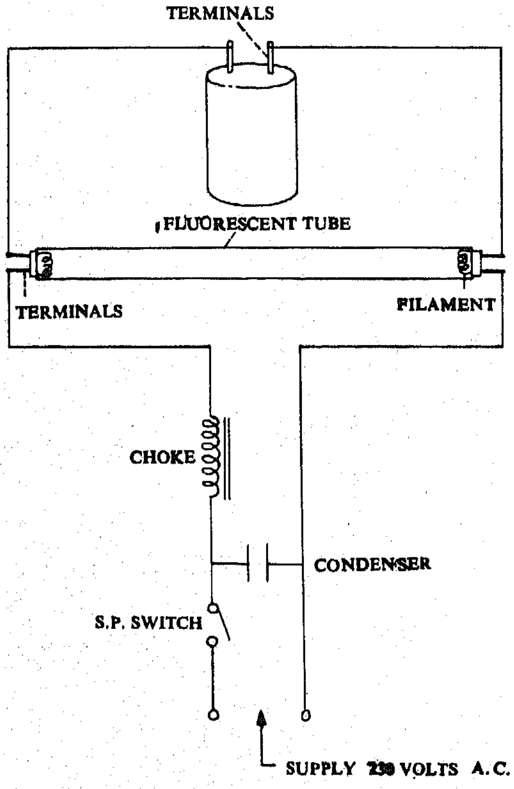

Fig. 23.4 FLUORESCENT TUBE CIRCUIT WITHOUT BLEEDER RESISTANCE FOR A.C. SUPPLY

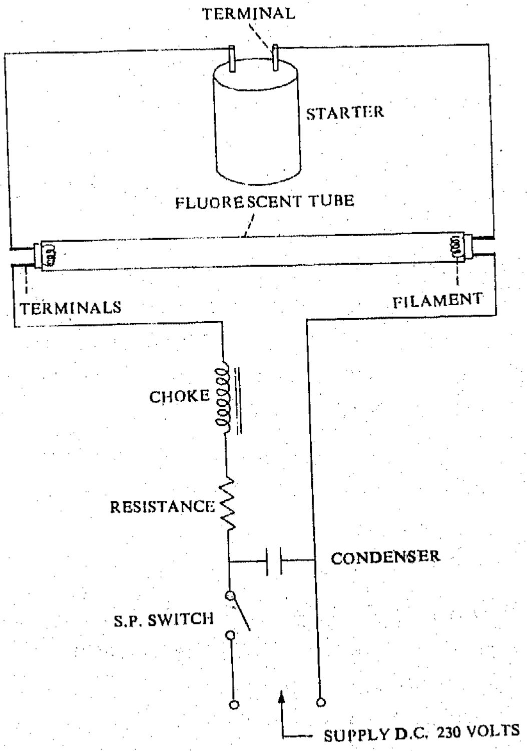

Fig. 23.5 FLOURESCENT TUBE CIRCUIT WITH BLEEDER RESISTANCE FOR D.C. SUPPLY

ACTIVITY 24 *Time Required* : Two Hours

Preparing a Test Lamp

Objectives

(i) Preparing a test lamp and using the same to trace continuity in electrical circuit.

(ii) To trace the phase and the neutral in the supply mains.

(iii) To prepare a parallel test lamp and a series test lamp and use them for testing.

Related Information

Test lamp is a very simple but useful testing device. It is used for fault-finding in electrical circuits and in electrical appliances.

A parallel test lamp is used to find out the phase and the neutral in the supply (Fig. 24.1).

A series test lamp can be prepared by using a normal parallel test lamp. It is used to find out the continuity of the circuit (Fig. 24.2).

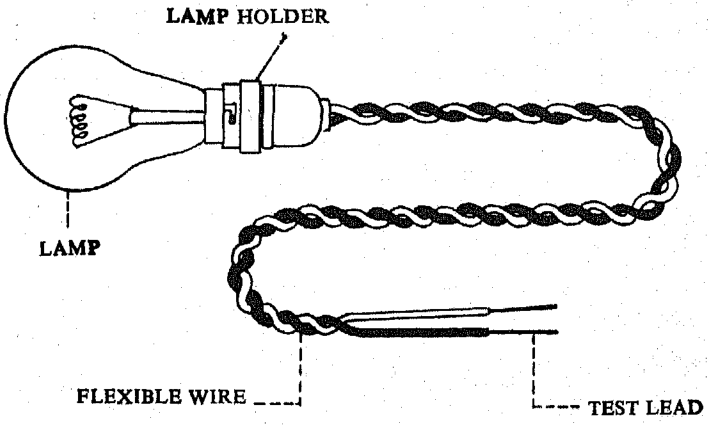

Fig. 24.1 PARALLEL TEST LAMP

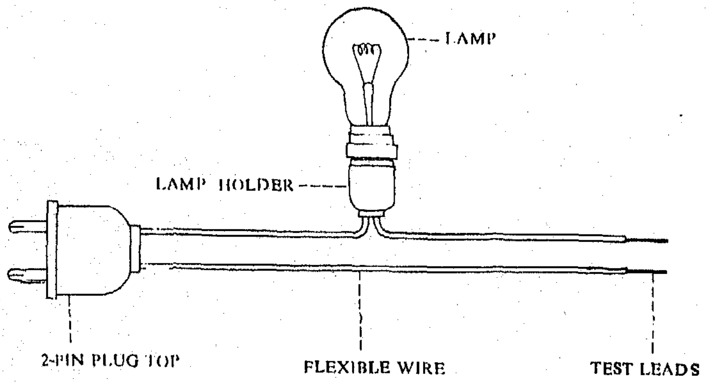

Fig. 24.2 A SERIES TEST LAMP

Tools, Equipment and Materials Required

Tools

(i) Screw-driver 15 cm : 1
(ii) Electrician knife 15 cm : 1

Materials

(i) Pendent lamp-holder 5 A, 230 volts : 2
(ii) PVC flexible wire (23/0.193 copper) : 4 metres.
(iii) Two-pin socket 5A, 230 volts: 1
(iv) Lamp 40 watts, 230 volts: 2

Procedure

(i) To prepare a parallel test lamp, take two pieces of 23/0.193 PVC flexible wires each one metre long. Strip the insulation from each end. Connect the ends of the wires to the lamp holder. The other ends of the wires can be used as test leads.

(ii) For testing the supply, connect the ends of the test lamp in the main switch to the supply side. If the lamp glows, there is supply (Fig. 24.3).

(iii) For testing the phase and the neutral, connect one lead of the test lamp to the terminal and the other wire of the test lamp to the earth point. If the lamp glows, the wire connected to the test lamp is the phase wire and another is the neutral wire. (Fig. 24.4).

(iv) For preparing a series test lamp, connect the pendent lamp holder and the 2-pin plug top

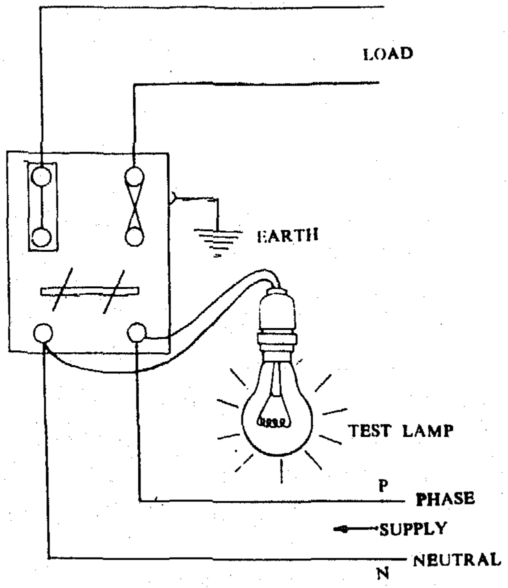

Fig. 24.3 TEST LAMP CONNECTION FOR CHECKING SUPPLY

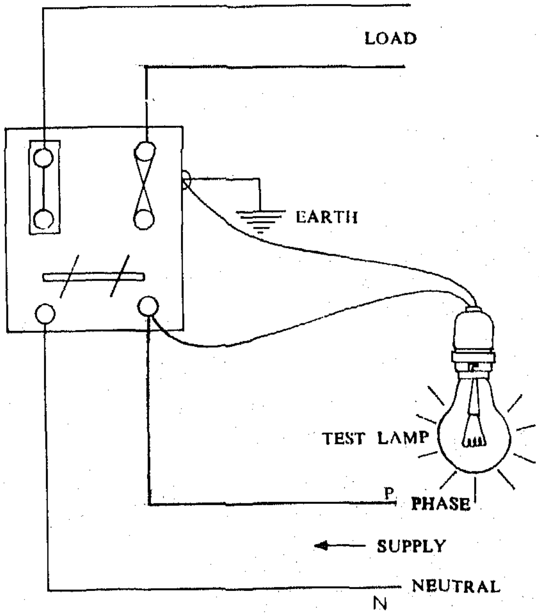

Fig. 24.4 TEST LAMP CONNECTION FOR CHECKING PHASE

as shown in Fig. 24.2. The two other ends will act as test leads.

(v) If the plug top is placed in the mains socket and the test leads of the series lamp are touched together and the lamp glows, there is supply in the socket. If the lamp does not glow there may not be supply in the socket or the circuit may be open.

(vi) When the metal frame of an electrical appliance and one of its terminals are connected to the series test lamp and the lamp glows, it means that the appliance has become short-circuited.

Precautions

(i) Do not touch bare test leads during testing.
(ii) Hold the test lamp firmly during testing.

Applications

(i) Test lamps are used to find out whether there is supply in the wiring.
(ii) To find out continuity in a circuit.
(iii) To find out the phase and the neutral in the mains.
(iv) To find out ground fault in electrical appliances.

ACTIVITY 25

Time Required : Two Hours

Preparing an Extension Power Cord with Fuse and Indicating Lamp

Objectives

(i) To prepare extension power cord having a fuse as a safety device and an indicating lamp.

(ii) To make supply available at a working or distant place.

Related Information

An extension power cord provides supply at a working place or at a distant place from the main supply point. A fuse is connected in series with the supply for safety. The indicating lamp indicates power existance. A three-pin power socket makes provision for extension of power supply. A switch controls the power feeding to the extension socket. Connect switch in live wire. Connect earth terminal to earth wire.

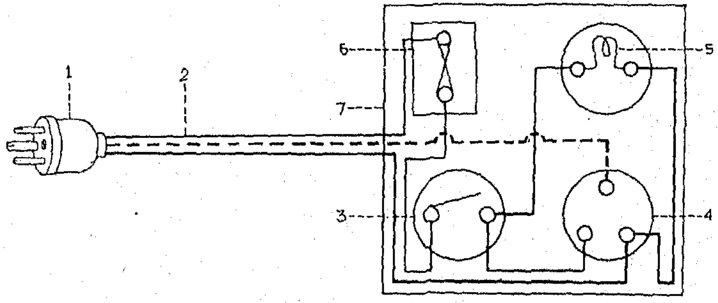

Fig. 25.1 EXTENSION POWER CORD WITH FUSE AND INDICATING LAMP

1—THREE-PIN PLUG TOP 15A, 230 V
2—THREE CORE POWER FLEXIBLE CORD
3—SINGLE POLE SWITCH 15A, 230 V
4—THREE-PIN SOCKET 15A, 230 V
5—INDICATING LAMP
6—KIT-KAT FUSE 15A, 230 V
7—TEAK WOOD BOARD

Tools, Equipment and Materials Required

Tools

(i)	Screw-driver 15 cm	1
(ii)	Connector Screw-driver 10 cm	1
(iii)	Insulated Combination pliers 15 cm	1
(iv)	Poker 15 cm	1
(v)	Electrician's knife	1

Materials

(i)	Three-core PVC flexible wire 23/0-0076 mm (23/35 SWG)	2 metres
(ii)	Kit-kat fuse 15 A, 230 volts	1
(iii)	Neon indicator lamp 230 volts	1
(iv)	Single Pole Switch 15 A, 230 volts	1
(v)	Three-pin Socket 15 A, 230 volts	1
(vi)	Teak wood board 30 cm x 30 cm	1
(vii)	Three-pin plug top 15 A, 230 volts	1

Procedure

(i) Collect materials as per the requirement.

(ii) Mark the various positions of the components on the board.

(iii) Drill holes for entry of wires and for fixing the components.

(iv) Fix the components as per the diagram.

(v) Remove insulation about half centimetre.

(vi) Connect connecting terminals by 3/22 PVC wire, inside the board.

(vii) Connect three-pin 15 ampere plug top to another end of the flexible power cord to tap the supply from the mains.

(viii) Complete the wiring as per the diagram. Tighten all screws of the terminals firmly.

(ix) Care should be taken to connect the earth wire inside the board, which is meant for connecting to the three-pin socket earth terminal.

(x) Test the extension power cord by connecting to the mains. Test the socket by the test lamp.

Precautions

(i) All connections should be firm.

(ii) The phase should be connected through the fuse cutout.

(iii) The neutral and the earth connections should be carefully connected to respective terminals.
(iv) All accessories should be fixed properly.
(v) Close the backside of the extension power cord board by plywood with screws.

Application

(i) This is used in domestic installation where the power has to be made available at a distant place from the existing mains.
(ii) Used for extension of power for utilization.

ACTIVITY 26

Time Required : Two Hours

Preparing a Distribution Board

Objectives

(i) To develop skills for preparing a distribution board.
(ii) To protect a live wire by a fuse of suitable rating as per the load requirement.

Related Information

Wiring circuit should not exceed 800 watts load in any case for any type of load. Power plug circuit should not have more than two outlets per circuit. The power circuit should be designed for a load of 1 kilowatt. Thus distribution of load, by making circuits in house-wiring is widely used these days. By distributing load in circuits all the lamps are maintained at the same voltage.. The system of distribution is capable of further extension and as each circuit is protected by a fuse, there is more safety for the wiring.

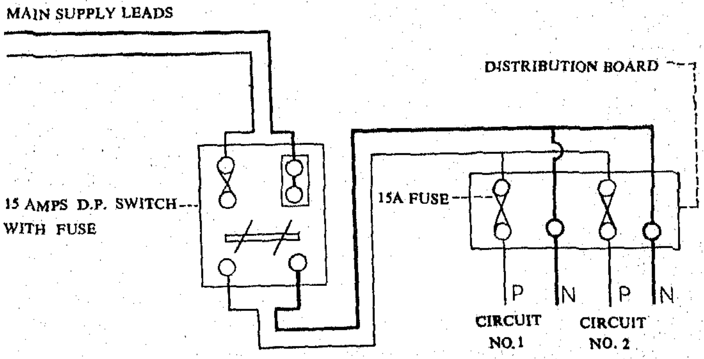

Fig. 26.1 DISTRIBUTION BOARD

Tools, Equipment and Materials Required

(i) Screw-driver 20 cm	1
(ii) Connector 10 cm	1

(iii)	Insulated combination pliers 15 cm	1
(iv)	Poker 15 cm	1
(v)	Electrician knife	1
(vi)	DP Switch 30 amp, 230 volts	1
(vii)	15 amp Kit-kat fuse	2
(viii)	Teak Wood Board 20 cm x 15 cm	1
(ix)	Teak Wood Board 30 cm x 15 cm	1
(x)	1/18 PVC Wire	4 metres
(xi)	Wood Screws 50 mm	6
(xii)	Wood Screws 12 mm	4
(xiii)	PVC Pipe Bends 12 mm	4
(xiv)	Saddles 12 mm/dia	12
(xv)	PVC Pipe 12 mm/dia	2 metres

Procedure

(i) Collect the required materials as per the list.
(ii) Calculate the total number of circuits to be made.
(iii) Lay out the double pole switch and distribution board, along with fuses as per the diagram.
(iv) Connect the intermittent wires inserting them inside the PVC pipes and bends.
(v) On each circuit connect other lamp loads.

Precautions

(i) Care should be taken to see that the lighting load circuit wattage does not exceed 800 watts in any case.
(ii) Place a fuse wire in the lighting load circuit of five ampere capacity.

Application

The distribution boards are provided for proper load distribution in house-wiring for the safety of the wiring installation.

ACTIVITY 27

Time Required : Three Hours

Wiring Two Lamps and a Two-pin Socket in CTS/TRS

Objectives

(i) To make the layout as per the circuit diagram correctly.
(ii) To cut and fix teak wood battens, boards and blocks as per the layout.
(iii) To connect the accessories as per the circuit diagram and to test the circuit.

Related Information

CTS/TRS wiring is used in domestic house-wiring. The switch is always connected in series with the live wire. A two-pin socket is used only for lighting load extension. However nowadays it is always recommended to have three-pin socket of 5 amp, 230 volts capacity in house-wiring. The earth point with earth connection will prevent electric shocks.

Tools, Equipment and Materials Required

Tools

(i)	Four-fold foot rule 30 cm	1
(ii)	Screw-driver 20 cm	1
(iii)	Connector Screw-driver 15 cm	1
(iv)	Insulated Combination Pliers 30 cm	1
(v)	Tennon Saw 60 cm	1
(vi)	Chisel 12 mm	1
(vii)	Poker 15 cm	1
(viii)	Hand Drill Machine 5 mm	1
(ix)	Electrician Knife 15 mm	1

Materials

(i)	CTS/TRS Wire 1/18 size	8 metres
(ii)	Teak-Wood Batten 15 mm x 15 mm	3 metres

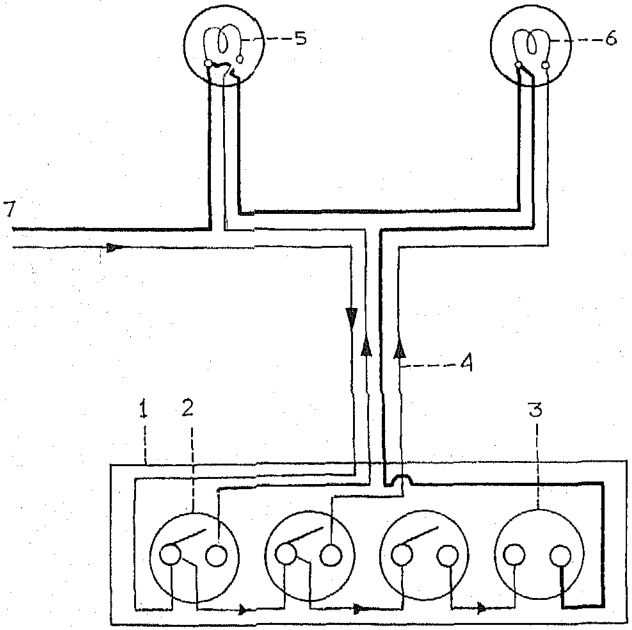

Fig. 27.1 CIRCUIT FOR WIRING TWO LAMPS AND A 2-PIN PLUG IN CTS/TRS

1—TEAK WOOD SWITCH BOARD
2—SINGLE POLE SWITCH, 5A, 230 V
3—2-PIN SOCKET
4—1/18 CTS/TRS WIRE
5—LAMP 1
6—LAMP 2
7—MAIN SUPPLY

(iii)	Link Clips 35 mm	30
(iv)	Nails 12 mm	20 grams
(v)	Teak Wood Board 30 cm x 15 cm	1
(vi)	Teak Wood Round Block 10 cm x 3 cm	2
(vii)	Screw 12 mm	12
(viii)	Screw 50 mm	6
(ix)	Screw 20 mm	6
(x)	Single-pole Tumbler Switch 5 A, 230 volts	3
(xi)	Two-pin Socket 5 A, 230 volts	1
(xii)	Bakelite Batten holder 5 A, 230 volts	2
(xiii)	Lamps 40 watts, 230 volts	2

Procedure

(i) Make the layout on the working board or on the wall.
(ii) Cut the battens as per the layout or circuit diagram.
(iii) Fix the link clips at a distance of 30 cm on the battens.
(iv) Fix the battens on the working board or on the wall.
(v) Lay the wires on the battens through the clips.

(vi) Strip the wires at the end.
(vii) Place the accessories according to the circuit diagram or layout. Make holes and fix with screws.
(viii) Connect all terminals according to the diagram.
(ix) Connect the circuit by giving supply.
(x) Test the circuit.
(xi) Test the socket with the test lamp.

Precautions

(i) Fittings should be tight enough.
(ii) There must be no bare wires inside the board.
(iii) Two wires in the socket should not touch each other.
(iv) Insulate yourself before switching on the supply.
(v) Wood screws should be tightened and not hammered.

Application

It is used in house-wiring for lighting, load extension as well as for general purposes.

ACTIVITY 28

Time Required : Four Hours

Wiring Three Lamps and Two Three-pin Sockets in CTS/TRS in Two Circuits

Objectives

(i) *To make the layout diagram correctly.*
(ii) To cut and fix the teak wood battens, boards, blocks as per the diagram.
(iii) To connect the accessories as per the circuit diagram.
(iv) To make circuits in wiring system for distribution of the load.

Related Information

CTS/TRS wiring is used in domestic house-wiring. Single-pole switches are always connected in phase for independent control of lamps. Circuits are made for equal distribution of the load. Each circuit should be protected by a fuse. An independent circuit should have the maximum load of 800 watts. A separate wire should be drawn from earth mains to the terminal of the socket which connects to the earth

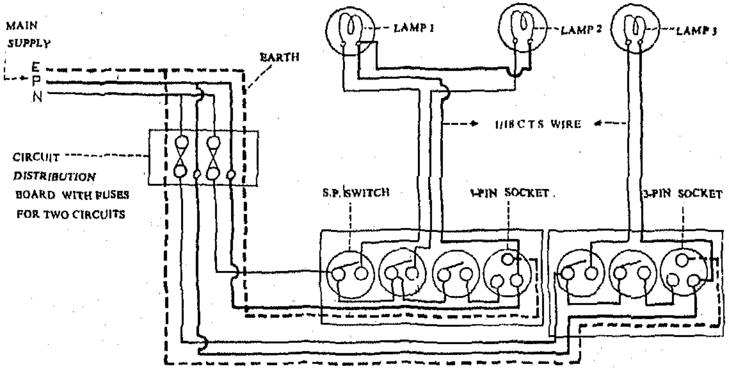

Fig. 28.1 CIRCUIT DIAGRAM FOR THREE LAMPS AND TWO 3-PIN PLUG WIRING IN TWO CIRCUITS

terminal of the appliance. Earthing connection wards off shocks and hazards. For lighting extension socket, a three-pin, 5 amp. socket should be used and for power extension a three-pin, 15 amp. socket should be used.

Tools, Equipment and Materials Required

Tools

(i)	Tennon Saw 60 cm	1
(ii)	Chisel 12 mm	1
(iii)	Screw-driver 15 cm	1
(iv)	Connector Screw-driver 10 cm	1
(v)	Insulated Combination Pliers 15 cm	1
(vi)	Poker 15 cm	1
(vii)	Electrician Knife	1
(viii)	Hand Drilling Machine 0.5 cm	1

Materials

(i)	CTS/TRS Wire 1/18	16 metres
(ii)	Wood Batten 15 mm x 15 mm	4 metres
(iii)	Link Clips 35 mm	40
(iv)	Nails 12 mm	20 grams
(v)	Teak Wood Boards	
	a) 30 cm x 15 cm	1
	b) 22 cm x 15 cm	1
	c) 15 cm x 15 cm	1
(vi)	Teak Wood Round Block 10 cm × 3 cm	3
(vii)	Switch 5 A, 250 volts	5
(viii)	Three-pin socket 5 A, 250 volts	2
(ix)	Bakelite Batten-holders 5 A, 250 volts	3
(x)	Copper Wire 14 SWG	3
(xi)	Kit-kat Fuse 15 A, 250 volts	2
(xii)	Wood Screw 20 mm	24
(xiii)	Wood Screw 50 mm	13
(xiv)	Wood Screw 15 mm	26

Procedure

(i) Collect the tools and materials as per the list.

(ii) Mark the layout diagram on the wiring board or on the wall as per the circuit diagram.

(iii) Cut the batten, boards and round blocks as per the layout diagram which is done as per the circuit.

(iv) Fix the link clips on the batten and then fix the batten on the board or the wall.
(v) Lay the wires as per the circuit diagram and tighten the clips.
(vi) Mark the position of the accessories on the board or on the wall and drill holes. Then fix the accessories.
(vii) Draw and connect earth wire to the earth point of the three-pin plug socket.
(viii) Give supply and test the circuit.
(ix) Test the socket with the help of the test lamp.

Precaution

(i) Avoid sharp edges of the batten.
(ii) Circuits should be made wherever possible depending upon the load.
(iii) Each circuit should carry a fuse in it.
(iv) No fuse should be provided in the neutral line.
(v) Earth connections should be done tightly.
(vi) There must be no bare earth wire inside the board.
(vii) Use sleeve on the bare earth wire inside the board.

Application

(i) This type of wiring is used in house-wiring.
(ii) Circuits are provided to distribute connected load, thus protecting the installation.
(iii) Three-pin plug sockets are used for extension of 5 amp. rated lighting load for using household appliances.

ACTIVITY 29

Time Required : Three Hours

Testing of Wiring Circuit

Objectives

(i) To select and handle testing equipment.
(ii) To make proper connections for testing wiring installation.
(iii) To test the wiring circuit and record the results.
(iv) To use insulation tester (Megger) for continuity, and insulation test in electric installation.

Related Information

To ensure faultless operation of wiring the following tests are conducted before the wiring curcuits are energized.

(i) *Insulation Test*: This test has great importance. It deals with measuring insulation resistance in between the covering of the *conductor and the insulating support.* In insulation test two tests are conducted: (a) insulation resistance test between conductor and earth and (b) insulation resistance test between conductors.
By these tests a value of leakage current in between each conductor and earth and the quality of insulation can be determined.

(ii) *Continuity Test (open, closed circuit and short circuit)*: This type of test ensures the continuity, open circuit and short circuit in the wiring test if carried out by megger.

(iii) *Polarity Test*: This test is carried out to ensure that all switches are connected on live conductor and not on the neutral. This test can be carried out by the test lamp or megger.

(iv) *Earth or Ground Test*: The purpose of testing earth is to ensure that there is no leakage of current through the insulation. High insulation resistance in between live wire/neutral or any terminal is expected.

(v) *Earth Path Continuity Test*: This test determines the continuity of earth path. Apart from continuity of path the resistance in between the earth terminal and the earth electrode can be measured. The lower the resistance, the higher is the possibility of leakage current.

Tools, Equipment and Materials Required

Tools

(i)	Insulated Screw-driver 25 cm	1
(ii)	Connector Screw-driver 15 cm	1
(iii)	Insulated Combination Pliers 15 cm	1
(iv)	Electrician Knife 15 cm	1

Equipment

(i)	Insulation Tester (Megger) 50 Megohms, 500 volts	1
(ii)	Test Lamp	1

Materials

(i)	PVC Flexible Testing Leads	1 pair
(ii)	PVC Flexible Wire (25/0.193)	2 metres

Procedure

(i) *Conducting Insulaltion Test between Conductor and Earth*

(a) Put all the main switches off and remove all the fuses from the main switchboard.

(b) Insert all lamps and appliances in position, short plug sockets, put fuse, and keep all switches on in the circuit.

(c) Connect one lead of megger to earth point and the other lead to main board terminal meant for cutout. Rotate the megger handle to send current through closed circuit formed in between conductor and earth. Note down the reading.

The measured resistance for satisfactory wiring must not be less than

$$\frac{\text{50 megohms}}{\text{number of outlets (points + sockets)}}$$

It is desired that for complete installation the value of resistance measured should be more than 1 megohm.

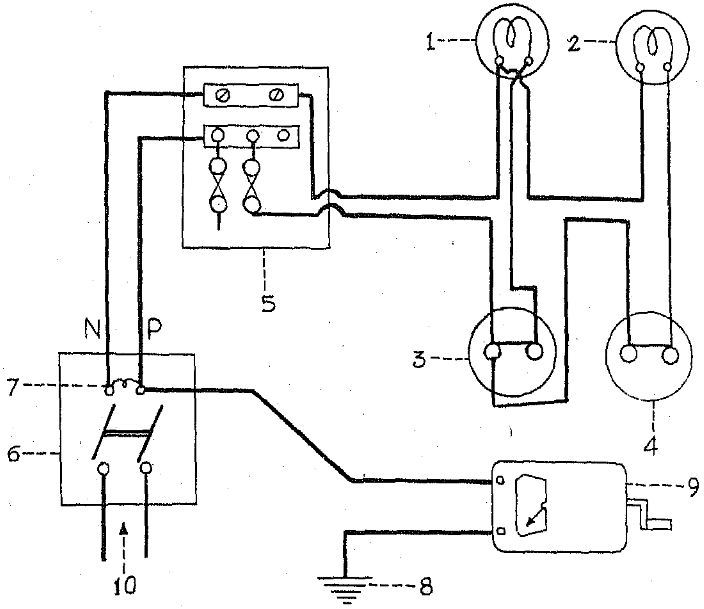

Fig. 29.1 INSULATION RESISTANCE TEST BETWEEN CONDUCTOR AND EARTH

1—LAMP 1
2—LAMP 2
3—SINGLE POLE SWITCH
4—SINGLE POLE SWITCH
5—DISTRIBUTION BOARD
6—CONSUMER'S MAIN SWITCH
7—LOOP CONNECTION
8—EARTH CONNECTION
9—MEGGER
10—MAIN SUPPLY

(ii) *Conducting Insulation Resistance Test between Conductors*

(a) Put on all the switches in circuit. Remove all lamps and appliances from the circuit.

(b) Connect the two megger terminals, one lead to one conductor and the other lead to the other conductor. Rotate the megger handle and record the reading. It is desirable to have higher resistance value. However the value of resistance should not be less than

$$\frac{50 \text{ megohms}}{\text{Number of outlets (points + plug)}}$$

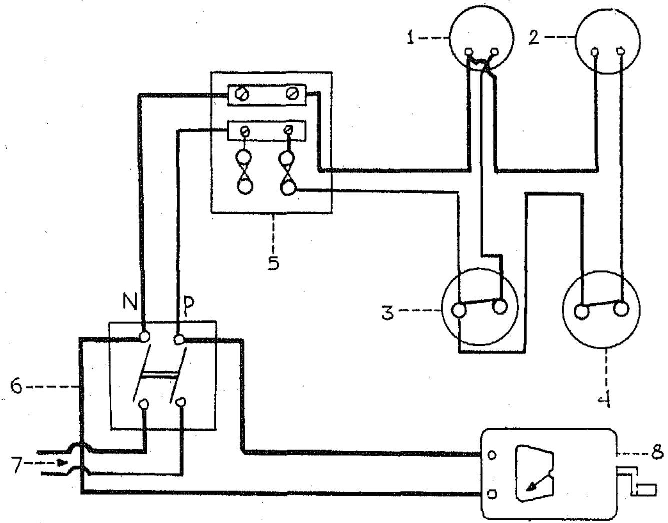

Fig. 29.2 INSULATION RESISTANCE TEST BETWEEN CONDUCTORS

1—CEILING-ROSE 1
2—CEILING ROSE 2
3—SINGLE POLE SWITCH
4—SINGLE POLE SWITCH
5—DISTRIBUTION BOARD
6—CONSUMER'S MAIN SWITCH
7—MAIN SUPPLY
8—MEGGER

(iii) *Continuity Test*

Continuity tests can confirm continuity, open and short circuit in the circuit. For this test, put on all switches of lamps and other load in the circuit. Connect the megger leads to the consumer load side terminals, that is for phase and neutral. Rotate the megger at the speed of 160 rpm. If the megger reads zero then the continuity in the circuit is all right. If the megger reads infinity or very high megohms reading, in that case the circuit is open. For short circuit test, disconnect all load from the circuit and read the megger. If the megger reading shows zero then there is short circuit in the circuit.

(iv) *Polarity Test*

Cut off the main supply and connect the megger leads to the live conductor terminal at the cutout point, and the other lead to the switch terminal as shown in Fig. 29.3. Zero reading shows continuity of live wire and the switch is on live wire. Infinity reading shows that the conductor/terminal is not on the live wire.

For testing polarity by the test lamp, take out all lamps and appliances from the circuit and energize the circuit. Connect one lead of the test lamp to the switch point and the other to earth point. If lamp glows, the switch is correctly inserted in the live line. If the lamp does not glow it means that the switch has not been correctly connected.

(v) *Earth or Ground Test*

For testing earth or ground fault, first connect one lead of the megger to earth point and the other lead of the megger to live wire terminal or neutral terminal or the terminal to be tested in the circuit. Rotate the handle of the megger and observe the reading. If the meter reads high megohms or infinity resistance, the insulation resistance is good and acceptable. If the megger reading is zero, then there is short or ground in between conductor and earth.

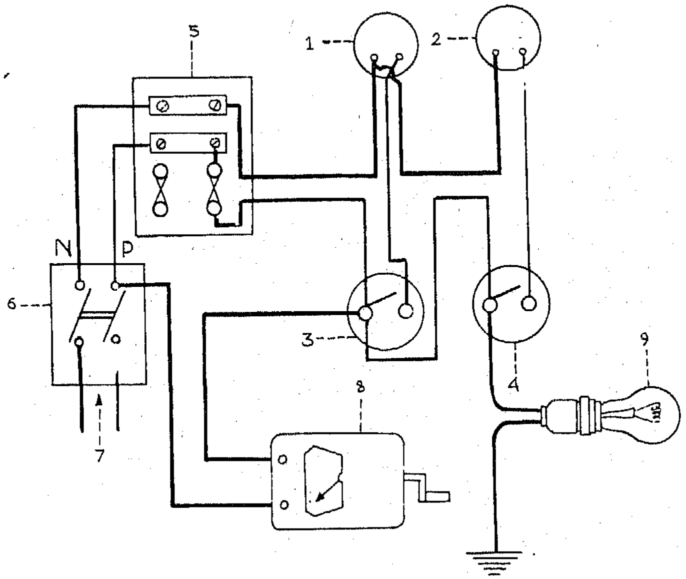

Fig. 29.3 POLARITY TEST BY MEGGER AND TEST LAMP

1—CEILING ROSE 1	6—CONSUMER'S MAIN SWITCH
2—CEILING ROSE 2	7—MAIN SUPPLY
3—SINGLE POLE SWITCH	8—MEGGER
4—SINGLE POLE SWITCH	9—TEST LAMP
5—DISTRIBUTION BOARD	

(vi) *Earth Path Continuity Test*

As there is possibility of loose connection in earth path, so a check on continuity and its resistance in between earth terminals to earth electrode is necessary. For this purpose connect one lead of the megger to any earth terminal. Rotate the megger handle at *the speed of 160 rpm and observe the megger* reading. If the megger reads zero then it is assumed that earth continuity is perfect. As per the ISI specification the total resistance of earth point to earth electrode should not be more than one ohm.

Precautions

(i) Megger should be selected keeping in view the voltage rating of the circuit.
(ii) Insulation tester should be checked for its performance before it is used.
(iii) Before testing the circuit by the megger be sure that the circuit is isolated from the mains.
(iv) Do not touch the megger terminals or leads while rotating the handle.

Application

The testing of installation is usually done for all types of circuits whether they are used for lighting or for power before they are charged.

ACTIVITY 30 *Time Required* : Ten Hours

Earthing for House-wiring

Objectives

(i) To prepare an earth pit for making proper earth connection for house-wiring.

(ii) To acquaint students with the utility of earthing.

Related Information

Earthing electrical equipment is very essential from the safety point of view. Earthing should have very low resistance, maximum two ohms. In electrical installation earth connections should be provided to (i) the metallic cabinet of each equipment and accessory, (ii) the frame of switch boards, control boards, individual panels, etc.

The types of earthing are:

(a) Plate-earthing, (b) Pipe-earthing.

Mostly pipe earthing is done for house-wiring. It is more economical than plate-earthing (Fig. 30.1).

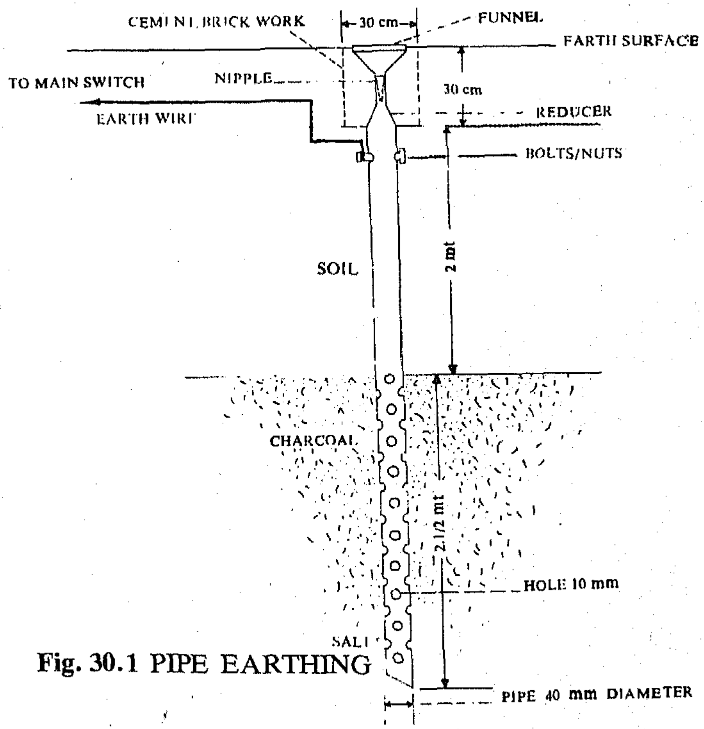

Fig. 30.1 PIPE EARTHING

Materials Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	G.I. Pipe.	40 mm Class 'B'	4.5 metres
(ii)	Aluminium Thimble	16 mm	1
(iii)	Bolt with Nut Washers	75 mm×5 mm	1 set
(iv)	Reducer G.I.	40 mm×25 mm	1
(v)	G.I. Nipple	25 mm×75 mm	1
(vi)	Funnel	25 mm	1
(vii)	Iron Mesh	10 cm×10 cm	1
(viii)	Charcoal		60 kg
(ix)	Salt		5 kg
(x)	G.I. Wire/Copper wire	8 SWG	30 metres
(xi)	Bricks		
(xii)	Cement/Sand		as required
(xiii)	Cover for pit	30 cm×30 cm×2 cm	1

Tools Required

S. No.	*Article*	*Specification*	*Quantity*
(i)	Drill Machine	10 mm	1
(ii)	Drill H.S.S.	10 mm	1
(iii)	*Hammer*	*450 gms*	*1*
(iv)	Hacksaw Frame	30 cm	1
(v)	Hacksaw Blade	30 cm	1
(vi)	Insulated Combination pliers	20 cm	1
(vii)	Insulated Screw-driver	15 cm	1

Procedure

(i) Collect the required material.
(ii) Dig the earth pit with the help of zig 20 cm up to a depth of 4.5 metres.
(iii) Make holes of 10 mm size on the pipe at a distance of 7.5 cms from the bottom of the pipe to the height of 2.5 metres.
(iv) Put the pipe into the pit.
(v) Put salt and charcoal into the pit.
(vi) Fix reducer, nipple and funnel at the top of the pipe.
(vii) Connect the G.I. wire to the pipe with the help of bolts and nuts and the thimble.
(viii) A small masonary brick work enclosure of 30 cm × 30 cm × 30 cm with a cast iron cover 30 cm × 30 cm × 1 cm on top for carrying out periodical inspection.
(ix) In the summer season the moisture in the soil decreases, thus causing an increase in earth resistance. The funnel on the pipe helps to pour water through it to keep the soil moist.
(x) Take the earth connection from the earth pipe to the main board with the help of G.I. or copper wire.

Precautions

(i) Earth resistance should be checked every two or three months.
(ii) Pour one or two buckets of water into the pit through the pipe to keep the soil moist and the earth connection good during summer days.

Application

To avoid accidents due to electrical shocks a good earth connection should be provided to every apparatus.

ACTIVITY 31 *Time Required* : One Hour

Familiarization with Rules of House-wiring

Objectives

To acquiant students with the rules of house-wiring.

Related Information

The students will be told about various rules for house-wiring. Knowledge of these rules is essential so that house-wiring is carried out uniformly in all places. Knowledge of these rules is also essential for doing house wiring safely and effectively.

House-wiring Rules as per the ISI Specifications

(i) The number of points in a light circuit is not to exceed 10 or the total load on the circuit is not to exceed 800 watts.

(ii) The switch board is to be fitted at a height of 1.5 metres.

(iii) The horizontal run of the wiring on the walls should be at a height of 3 metres.

(iv) Use only three-pin sockets.

(v) The minimum size of earth wire is 14 SWG of copper and 4 mm^2 for aluminium.

(vi) The fuse wire should be connected to the phase wire only.

(vii) Connect a neutral link in the neutral wire.

(viii) Connect all switches in the phase wire.

(ix) Choose the size of the conductor so that the voltage drop of the last point of the circuit is not more than 1+2% of declared voltage of supply.

(x) The minimum size of wire for light circuit is 1.00 mm^2 of copper and 1.5 mm^2 of aluminium.

(xi) For power wiring circuit, i.e. the circuit connecting electrical appliances, the minimum size of the wire is 1.5 mm^2 of copper and 2.0 mm^2 of aluminium.

(xii) For power wiring circuits, the number of points should not be more than two or the load should not exceed 2000 watt.

(xiii) All materials used in house-wiring, i.e. wires and accessories, should be of good quality, preferably having the ISI (Indian Standards Institution) mark.

ACTIVITY 32

Time Required : Six Hours

Reading Line Drawing of House-wiring

Objectives

- (i) To enable students draw simple line-drawing of house-wiring.
- (ii) To analyse and interpret line diagrams.
- (iii) To acquaint students with electrical symbols used in house-wiring.

Related Information

A line drawing is the plan of the wiring route that runs inside a building indicating the position of fittings and their controls, showing the number of circuits and load distribution. All details pertaining to installation of wiring are read out from the line diagram. It gives direction to the electrician as to how to proceed with electrification of the house. Electrical symbols are used to represent each accessory on the drawing and the circuit diagram shows how electrical accessories are to be connected. Before starting wiring a wiring plan (line diagram) has to be prepared and the position of switches, holders, plugs, fittings, etc., should be ascertained as per the requirement of the owner of the house. The line diagram guides the electrician in carrying out installation work without problem. Thus reading and understanding the line diagram is the first and foremost ability that has to be developed by an electrician.

Procedure

Let us draw a line diagram of wiring for a house (Fig. 32.1).

First mark the position of lights, fans, plug points, switches required in each room. Draw lines interconnecting all the points. Show junction boxes where main supply divides into two or more circuits

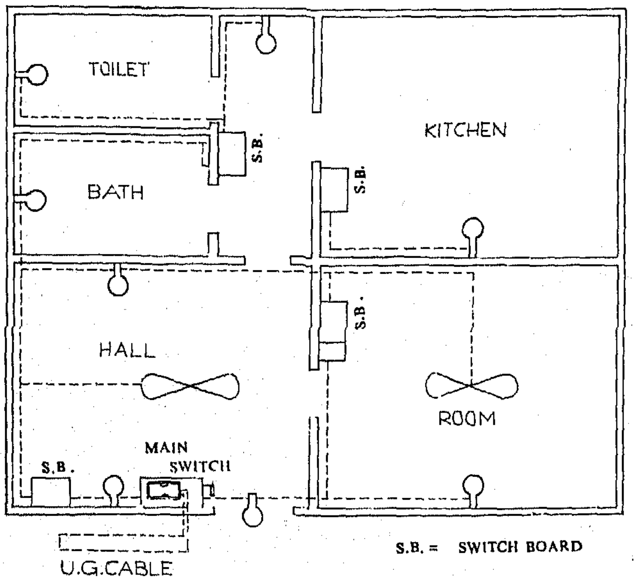

Fig. 32.1 LINE DRAWING FOR HOUSE-WIRING

Switches are connected on the phase wire and the neutral is connected to one terminal of lamp holders.

Electrical symbols in house-wiring are given in Fig. 32.2.

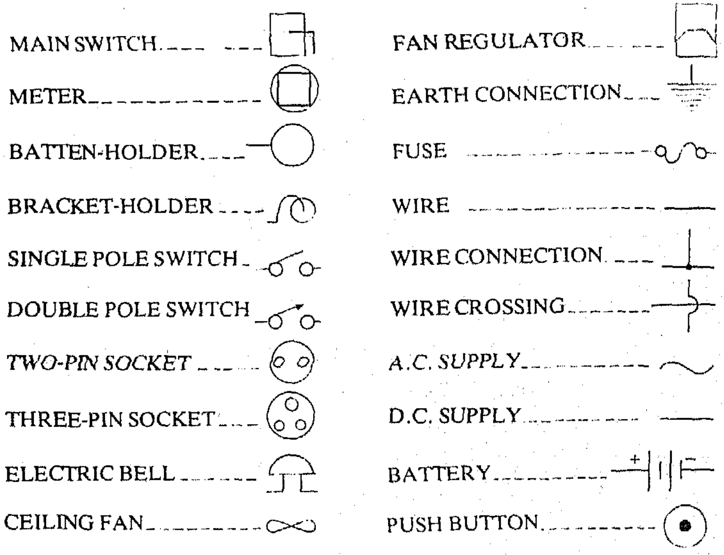

Fig. 32.2

Application

Line drawings are used for showing wiring routes on the building plan. It gives information about the type of fittings to be used, fan points to be provided, the number of light points the house contains, etc. It helps in the preparation of estimates to work out approximate expenditure. The line drawing is useful for locating faults that may occur in future and serves as a guide for later additions and/or alterations of the wiring system. The line diagram of the installation of the house is one of the documents to be enclosed to the prescribed form for getting approval and sanction for giving 'service' to the house. The line diagram of the electrical system is of great importance in house-wiring.

Precautions

(i) Do not connect more than 10 light points including wall plugs in a circuit.

(ii) Use two separate circuits with two double-pole switches if the house contains more than 10 points but less than 20 points and divide the total number of points equally on two independent circuits.

(iii) Exercise great care to show on the drawing necessary information about the wiring installation.

(iv) Use electrical symbols to indicate various accessories/fittings.

ACTIVITY 33 *Time Required* : Three Hours

Calculating Power Consumption of House-wiring Installation

Objectives

(i) To select and make proper connection of a single phase energy meter.

(ii) To record and calculate power consumption in a house-wiring.

Related Information

Every appliance is rated for a certain amount of its rate of doing work. The rate of doing work is called power. Power is given by the product of voltage and current. The small unit of power is watt and a bigger unit is kilowatt. When an appliance is used for a certain time, electricity is consumed. Energy charges are paid to the supply company for utilizing electricity. Energy charges are paid on the basis of units. The smallest unit of energy is watt hour and a bigger unit is kilowatt-hour (kWh). Energy meter is used to record energy consumed in an electrical circuit/wiring. It is connected in the main supply line of house-wiring. Energy meter is rated for various ratings such as its working volt, current rating. A proper range of meters should be selected and installed for wiring installation.

$$1\text{ kWh} = 1\text{ unit} = \frac{\text{Watts x hours}}{1000}$$

Assume that a 1000 watts heater is used for one hour, then the energy consumed is equal to

$$\frac{1000\text{ watts} \times 1\text{ hour}}{1000} = 1\text{ kWh} = 1\text{ unit}$$

Assume that in a house in wiring installation five lamps of 100 watts each are used for two hours per day. In this case the energy consumed in a 30-day month is equal to:

100 watts × 5 = 500 watts

$$\frac{500\ \text{W} \times 2\ \text{hours}}{1000} \times 30\ \text{days} = 30\ \text{kWh}$$

So 30 units of electricity are consumed in a month.

Example: Calculate energy charges to be paid to the electricity supply company for the following load in a house for a 30-day month. The rate of unit is 50 paise.

(a) Four lamps of 60 watts each are used for three hours per day.
(b) Two tube lights of 40 watts each are used for four hours per day.
(c) A television set of 80 watts is used for four hours per day.
(d) An electric heater of 2000 watts works for eight hours per day.

Solution

4 lamps × 60 W × 3 hours = 720 watts hours
2 lamps × 40 W × 4 hours = 320 watts hours
1 TV × 80 W × 4 hours = 320 watts hours
1 heater × 2000W × 8 hours = 16000 watts hours
Total = 17360 watts hours

$$\frac{17360}{1000} = 17.36 \text{ kilowatts-hours energy consumed per day}$$

So energy consumed in 30 days =
17.36 kWh × 30 days = 520.80 kWh
The bill for the month at the rate of 50 paisa per unit = 520.8 kWh × Rs. 0.50 = Rs. 260.40.
So Rs. 260.40 are to be paid to the electricity company for the power consumed in a month.

Tools, Equipment and Materials Required

Tools

(i) Screw-driver 15 cm	1
(ii) Insulated combination Pliers 15 cm	1
(iii) Electrician knife 15 cm	1

Equipment

(i) Energy meter 20 amp, 230 volts	1
(ii) Heater of 1000 watts	1
(iii) Stop watch	1

Materials

(i) Power cord (3 core) (23/0.00 76 mm)	2 metres

(ii)	A set of model having lamps and appliances in the circuit	1 set
(iii)	DP Switch 32 A, 220V	1
(iv)	Kit-kat Fuse 30 amps	1
(v)	Wooden Board 30 cm×30 cm	1
(vi)	Wooden Board 15 cm×15 cm	1
(vii)	15 amp. three-pin socket	1
(viii)	15 amp. SP Switch	1
(ix)	15 amp. three-pin Plug Top	1

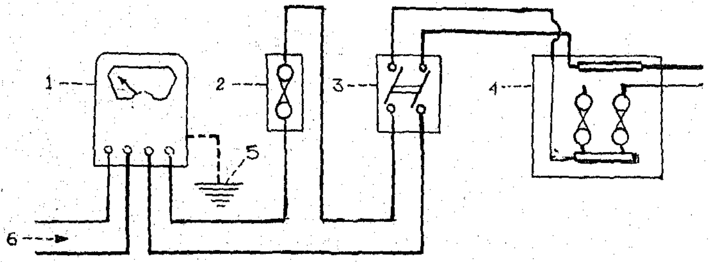

Fig. 33.1 CIRCUIT DIAGRAM FOR ENERGY METER CONNECTION IN HOUSE-WIRING

1—ENERGY METER
2—FUSE CUTOUT
3—CONSUMER'S MAIN SWITCH
4—DISTRIBUTION BOARD
5—EARTHING
6—MAIN SUPPLY

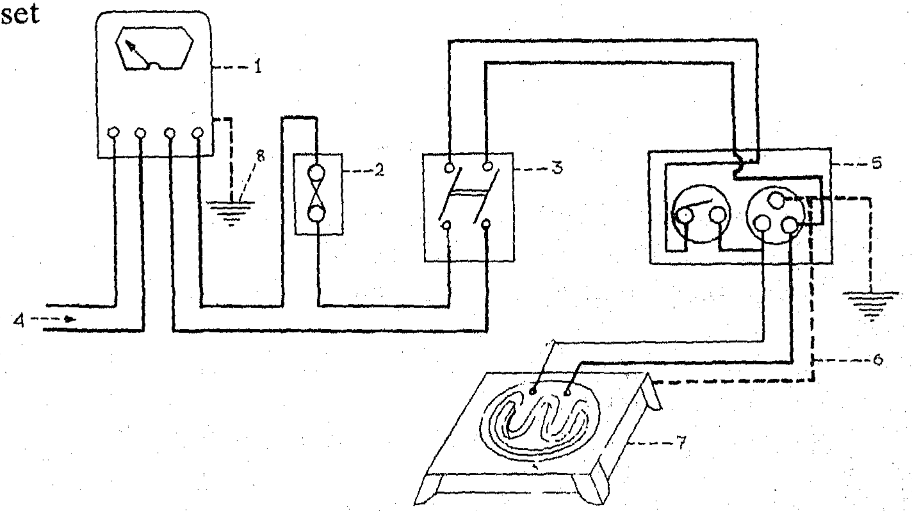

Fig. 33.2 CIRCUIT DIAGRAM TO CALCULATE POWER CONSUMED BY A HEATER

1—ENERGY METER
2—FUSE CUTOUT
3—CONSUMER'S MAIN SWITCH
4—MAIN SUPPLY
5—SWITCH BOARD
6—EARTH CONNECTION
7—ELECTRIC HEATER
8—EARTHING

Procedure

For calculating power consumed in house-wiring, first select the proper range of energy meter and connect the same as per Fig. 33.1. Put the load in the circuit and observe the energy meter reading. The difference of the original reading and the present reading gives the energy consumed in unit/kWh for that particular duration.

For calculating power consumed by a particular appliance or a heater, connect the appliance, energy meter, fuse cutout, DP switch, socket and switch as per the Fig. 33.2. Energize the circuit and note the time with the help of a time clock. Observe the reading. The following method gives the power consumed by a heater in terms of Unit/kWh.

Power consumed in Unit/kWh = Actual reading of meter – Original reading of the meter.

Precaution

(i) The energy meter should be selected keeping in view the voltage and the current rating of the installation.

(ii) The energy meter should be checked for its performance before it is used in the circuit.

(iii) Proper connection in the meter should be done otherwise it may not give forward reading.

Application

(i) Energy meters are used for calculating the power consumed in house/commercial installations.

(ii) Calculation of power consumed is done by the electricity supply company for the collection of energy charges from the consumer.